PROCEEDINGS

OF THE

ENTOMOLOGICAL SOCIETY

OF

BRITISH COLUMBIA

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NUMBERS THIRTEEN AND FIFTEEN

ECONOMIC SERIES

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VICTORIA, B.C.:
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BRITISH COLUMBIA ENTOMOLOGICAL SOCIETY.

PROCEEDINGS, 1921.

THE LOCUSTS OF BRITISH COLUMBIA.

By E. R. Buckell.

LOCUSTS or grasshoppers from an early date have been known to cause great losses to cultivated crops and to the native grasses in North America. The Rocky Mountain locust (**Melanoplus spretus**), which periodically appeared in dense clouds, flying from the breeding-grounds on the dry mountain-slopes to the lower lands in the valleys, was particularly feared by the early settlers. Arriving suddenly in a dense swarm, they would descend upon the cultivated portions of the valleys, and moving forward would leave the ground behind them completely cleared of vegetation, causing great losses. In Canada the Rocky Mountain locust is said to have been responsible for the great damage done during the severe locust outbreaks of 1868, 1870, 1872, and 1874. Since then, however, it has not occurred alone in sufficient numbers to do very serious damage. Its place, however, has been taken by several species, most of which are not migratory in their habits, but periodically become very numerous and destroy the crops in the neighbourhood of their breeding-grounds. As these species are often distributed over a large area, a sudden increase in their numbers will cause the destruction of crops and range grasses over that area, often resulting in an outbreak covering large tracts of land.

With the exception of **Camnula pellucida**, which belongs to the subfamily **Œdipodinæ**, the other species chiefly responsible for outbreaks in Canada belong to the subfamily **Acridinæ** and to the genus **Melanoplus**; these are: **M. atlanis, M. affinis, M. femur-rubrum, M. bivittatus, M. packardii**, and **M. spretus**. Species of other genera, and in some cases other families, have been recorded as present during outbreaks, but not in sufficient numbers to be of much importance.

The following brief outline of locust outbreaks in Canada is compiled from the reports of the Dominion Entomologist: In the years 1868, 1870, 1872, and 1874 serious locust depredations occurred in the Prairie Provinces, the Rocky Mountain locust (**M. spretus**) being chiefly responsible for the damage done. In 1893 the common red-legged locust (**M. femur-rubrum**) became very abundant in the Provinces of Ontario and Quebec. In 1894 a heavy outbreak of the lesser migratory locust (**M. atlanis**) caused great damage on Sable Island. In Ontario and Quebec the locusts continued to increase and in 1895 and again in 1896 caused great damage in these

Provinces, the species chiefly responsible being **M. atlanis, M. femur-rubrum,** and **M. bivittatus.** During these two years (1895 and 1896) these three species mentioned above were reported as injurious to crops and range grasses in several parts of Canada, especially where droughts prevailed. In 1896 the climax of this outbreak in Ontario and Quebec was apparently reached, for in 1897 these Provinces were comparatively free from locusts, the notable absence of locusts being probably due to the great abundance of their parasites in 1896. In 1898 a bad outbreak occurred in Manitoba, and this outbreak lasted until 1903. The commencement of this outbreak in Manitoba was important on account of the fact that in this year the Rocky Mountain locust (**M. spretus**), not an important species as regards damage done in Canada since the outbreak of 1868-1874, where it alone was responsible for most of the damage, was again the chief destructive specie. Three other species were recorded as present in lesser numbers—namely, **M. atlanis, M. minor,** and **Camnula pellucida.** In 1900 this outbreak in Manitoba was still serious; **M. spretus** was, however, not so much in evidence, but **M. packardii,** with **M. atlanis** and **Camnula pellucida,** were the chief destructive species. During the years 1901 and 1902 the Manitoba outbreak continued, but was controlled locally by the use of poisoned bran-mash. At this time **M. atlanis** was the chief species present; **M. spretus** and **M. packardii** were on the decrease, **M. bivittatus** and **Camnula pellucida** taking their places. In 1903 the same species as in the past three years were again numerous in Manitoba, but this appeared to be their final year in this particular outbreak, for in 1904, 1905, and 1906 no serious damage from locusts was reported. In 1909 and 1910 parts of Manitoba and Ontario and Quebec were again injured by locusts. In 1914 and 1915 Ontario suffered badly from the ravages of **M. atlanis** and **Camnula pellucida.** During the year 1916 no serious locust damage was reported.

LOCUST OUTBREAKS IN B.C.

The accounts of these outbreaks are taken from the reports of the Dominion Entomologist, except that in the account of the 1914 outbreak in the Nicola Valley the report of Mr. R. C. Treherne, Field Officer, Dominion Entomological Branch, was the chief source of my information, and in 1919 I was able to visit the outbreaks myself. The earliest record of locust-injury in British Columbia contained in these reports is in 1890, where locusts are reported to have "caused complete havoc in the Nicola Valley. In 1895 **Camnula pellucida** was extremely abundant and destructive between Vernon and Kelowna."

The next outbreak we hear of in British Columbia is in 1898 in the Nicola Valley, and in a letter from Mr. Pooley to the Dominion Entomologist of September 7th, 1898, he says: "Injury done by the hoppers was principally to the ranges and bunch-grass pasture-fields; also considerable injury to the oats, by their eating off the small stem which connects the grain with the straw, and consequently all the oats were lodged on the ground. Injury to wheat, not any; peas scarcely perceptible. This is the second time the grasshoppers have appeared in our valley. The first time

(which was in 1890) they made complete havoc, and unless something happens to destroy the eggs before hatching it will be very little use putting in a crop next spring. The eggs are deposited on sandy and gravelly hills (about an inch below the surface). Some of the eggs seem to have become dried, but the majority are quite fertile. Nearly all the grasshoppers have disappeared and a great many have died."

Mr. S. J. Solomon, in a letter to the Dominion Entomologist, says: "Nicola Lake, December 31st.—I could not grow enough feed to keep any quantity of hogs. The grasshoppers were very bad last summer and laid their eggs, so that we are expecting our crops will be all eaten by them next year. I shall put in very little wheat or oats, but principally peas and potatoes, as they do not bother these crops so much.

"The early disappearance of the locusts mentioned by Mr. Pooley would indicate the probable presence of parasitic insects or some fungous or bacterial disease. The most numerous species was **Camnula pellucida,** which is sometimes extremely abundant and destructive in the West. This was the case between Vernon and Kelowna in 1895. The other species present were **Trimerotropis** (probably **cincta**), **Circotettix verruculatus,** and **M. atlanis.**" During the years 1900 and 1901 reports were received by the Dominion Entomologist of considerable damage to crops and range land in British Columbia. In 1900 it was in the Okanagan Valley where most of the damage was done, where **M. atlanis** and **C. pellucida** were numerous and attacked grain-crops and bunch-grass pasture lands.

In the following year, 1901, the locusts had increased in numbers and were doing considerable damage in several parts of the Province. **M. atlanis** damaged the foliage of fruit-trees and forage-crops on the Coldstream Ranch at Vernon. The Nicola Valley was another district which was badly damaged in 1901, and the range country between Nicola and Kamloops showed many instances of their destructiveness. Throughout this district the grasses on the ranges were severely damaged and the foliage of trees and shrubs in the gullies was attacked. Where cultivated crops occurred, grain-crops, turnips, and garden produce was destroyed by them. The locusts responsible for this destruction in the Nicola-Kamloops region were **Camnula pellucida** and **M. affinis** the former doing the most damage. Locusts were again noticed in numbers in the Okanagan Valley in 1903, and although no serious damage was reported, there was considerable anxiety felt by the ranchers in this region lest there be a repetition of the outbreaks of 1900-1901. The grey-spotted blister-beetle (**Epicauta maculata**) was abundant in 1903, feeding on wild plants, and as this insect is predaceous on the locust it was no doubt partly due to its presence that the locusts did not increase in the Okanagan Valley. The locust **Camnula pellucida** was fairly numerous in parts of the Dry Belt in 1904 and again in 1907, in which year it did considerable damage, but from this date until 1914 no serious outbreaks of locusts were reported from the Province.

In 1914 the locusts were again present in destructive numbers and young orchards of apple and pear trees were damaged in the Okanagan Valley by **M. atlanis.** The Nicola Valley was again attacked by locusts,

M. affinis being the most numerous species present. An investigation of the conditions was made by Mr. R. C. Treherne at the request of the Dominion Entomologist and Provincial Government Forestry Branch, and extracts from his report are given below:—

"It was reported from the Department at Ottawa that close upon 200,000 acres of bunch-grass had been laid waste during the summer of 1914 in the Nicola Valley owing to the outbreak of the locust **M. affinis.** The attacks from this insect had been increasing during the last three or four years. Mr. Cleasby, of Coutlee, near Merritt, Secretary of the Nicola Stock-breeders' Association, said 'that in his recollection the years surrounding the periods of 1898, 1907, and the past summer of 1914 were the most serious cases on record.' I gathered from Mr. Ward, of the Douglas Lake Cattle Company, that the locusts began around the Minnie Lake District, a point 25 miles south of Quilchena, and passed through, investing Quilchena to the west and Douglas Lake to the east, going north nearly to Stump Lake. This area approximately involved land 40 miles by 20 miles and was the centre of the outbreak, while outlying points such as Merritt suffered to a lesser degree. On the afternoon of November 6th I made a detour of the hills on foot around the house and buildings at Quilchena. On one small hill immediately behind the house I found innumerable eggs. I took an area 3 feet by 1 foot and carefully sifted over the soil by means of a hand-trowel. I should judge that between 300 and 400 eggs existed to the square foot of soil, 3 inches deep. Eleven predatory larvæ were taken in the area 3 feet by 1 foot; thus approximately four predatory larvæ demolish 300 eggs. The hill in question was just a slight rise off the general level of the land, dry, practically devoid of vegetation, and the soil mostly clay, but very plentifully mixed with loose rock and fine shaly stones. The greatest number of eggs were found at the summit of the hill, but eggs could be found easily on the sides and at the base of the hill. On the open slopes and level places eggs could be found here and there, but were scattered and not together in restricted areas, which was the case on slightly rising ground and hill-tops where the soil was gravelly or clay well mixed with small stones, etc. Larvæ of predatory beetles were found freely where eggs were thickest, while with the isolated clusters no beetle larvæ were found. Mr. Guichon, of Quilchena, said that, of course, locusts were with them every year, but that for the years surrounding 1889, 1898, 1907, and 1914, and for approximately three years surrounding these dates locusts did a great deal of damage. Probably the 1889 outbreak was the most serious.

"In 1919 locust outbreaks occurred in four widely separated points in British Columbia. The first outbreak reported was between Bridesville and Rock Creek, in the Boundary country, where a large swarm of **Camnula pellucida** which had been working north through Washington State since 1914 crossed the Canadian boundary in this section. Considerable damage was done to the grain-crops. An active campaign, however, was started in Washington in 1918 and continued in 1919, and the Canadian farmers

were enabled to obtain the poison-bran bait for distribution from the Washington authorities, with the result that this outbreak is, we believe, definitely checked. The next report was from Celista, on the Shuswap Lake. In this locality there was a clearing in the bush of 400 acres, and a large swarm of **Melanoplus atlanis** had been devouring everything that the settlers planted during the last three years. This year they were again bad, and when I visited the clearing in the middle of August I found that they had made a clear sweep of the vegetation in the clearing and were moving off into the bush on all sides, in dense swarms. The third outbreak was reported from the Fraser Valley, between Huntingdon and Clayburn, where **Melanoplus femur-rubrum** was numerous and was doing some damage to grain and truck crops. The last report was from the Chilcotin District at a point situated 150 miles north of Ashcroft. I was not able to visit this point until the frost had killed all the grasshoppers, but from the remains found I do not think that there is any doubt that **Camnula pellucida** was the species causing the damage. In this district the ranges had been eaten bare by the grasshoppers over an area of several hundred square miles, and was by far the most serious outbreak that has occurred in British Columbia for some years."

CONTROL MEASURES.

Introduction.—There are several methods employed in controlling locusts which vary according to the stage the locusts have reached when the control is to be started. In some cases the eggs may be destroyed by ploughing the breeding-grounds in the fall, and thus exposing the eggs to the frost and enemies, such as birds, mice, etc. The eggs that are turned under by the plough will probably be buried deep enough to prevent the hoppers from reaching the surface in the spring when they hatch. This method is most often successful with the pellucid locust (**Camnula pellucida**), as this species lays its eggs in concentrated areas. With other species this method is often impossible owing to the fact that the eggs are laid in an irregular manner over a large area, and not collected together in certain definite breeding-grounds. In this case other methods have to be relied upon, such as poisoning the young adults or by the use of hopper-dozers and other hopper-catching machines. In the United States, where locust-control has been carried on for many years, a number of poison-bait formulas have been tried out with varying results.

Baits.—From the experiments conducted in Canada it has been found that up to the present time the most successful formula is the Kansas formula, though in some localities where considerable moisture exists in the air during the day, and the bait does not dry out too rapidly, the Criddle mixture has proved equally efficient and less expensive.

The Kansas formula consists of: Bran, 20 lb.; Paris green, 1 lb.; molasses, 2 quarts; oranges or lemons, 3 fruits; water, 3½ gallons.

The Criddle mixture is made by mixing: Horse-manure, 60 parts; Paris green, 1 part; salt, 2 parts.

In the dry climate existing throughout the Dry Belt of British Columbia the Criddle mixture would probably dry up too quickly to prove of much use, as the locusts will not eat it unless it is fairly fresh and moist. The Kansas formula, however, is eaten by them very readily when damp, and they will also continue to eat it dry, but not so readily. The substitution of sawdust in the place of bran has been tried and seems to have proved very successful. It is, however, harder to mix properly, as the sawdust does not absorb water so readily as bran, and in adding water the Paris green is apt to be washed off the sawdust. Some idea may be had of the effect of the poisoned formulas from the fact that in experiments conducted in Ontario and Quebec from 210 to 1,200 dead locusts were counted to the square yard. The count was made four days after the bait was spread, giving an average of 514.2 dead locusts to the square yard.

Preparation.—In mixing the bran-mash the bran and Paris green should be mixed together dry. This is best done by adding the Paris green slowly as the bran is stirred around in a tub or box. In the States, where they have had large areas to treat, the mixing has been done on large cement floors of barns, using shovels to mix the bran and Paris green; or, if done in the open, a good way is to put tarpaulin wagon-covers or canvas sheets on the ground, spread the bran on these in a thin layers, and, after scattering the Paris green over the bran as evenly as possible, roll the ingredients together by lifting the sides of the wagon-cover alternately until they are thoroughly mixed. A tight wagon-box is a good place to mix a few hundred pounds of bait. The molasses and lemon-juice should be added to the water and thoroughly mixed, the rinds of the lemons being chopped up fine and added to the mixture. The lemons may be best cut up by passing them through a mincing-machine. When the liquid materials are well mixed, sprinkle them over the bran as evenly as possible, a watering can being found most useful for large quantities. Care should be taken that the mixture is not made into a sloppy mass, but that each flake of the bran is moistened by the liquid. If the bait is made too wet it will stick together in lumps when spread on the fields.

Distribution.—This should be guarded against, as it is not nearly so efficient as a bait unless evenly distributed in flakes. When distributed in flakes it would be found and eaten by a far larger percentage of the locusts than it would if it were scattered in lumps here and there. Further, the risk of poultry or stock eating it and getting poisoned is obviated. The best time to poison locusts is when they are still immature and have not yet got their wings, the bait being spread broadcast over the areas most frequented by them. This should be done either overnight or early in the morning, so that it will be moist and most readily attract the locusts when they commence to feed in the morning. Where small quantities are to be used it may be broadcasted by hand, but where larger tracts are to be treated it can be most conveniently carried in barrels in a wagon and spread as widely as possible with a trowel or a shingle. In parts of the United States (Montana, Utah) where it was necessary to treat a large

tract of range land the farmers co-operate, and by meeting on a certain day they all help in mixing and spreading the bait. Boilers are used on such occasions to mix the liquids in; the hot water more readily mixing with the molasses and bringing out the full flavour from the chopped-up lemon-rinds. While the liquids are being prepared wagon-covers, sheets, etc., are spread on the ground and the bran and Paris green mixed ready for the liquids to be added. Some mixing is also done in wagon-boxes in the field. Towards evening, when all the mixing has been done and the poison bait put into the wagons, the mixture is spread broadcast by men standing in the back of the wagons. The wagons are lined up so that there would be no ground left uncovered and driven forward in line over the areas previously mapped out, spreading the bait at the same time. Men on horseback are employed to keep the wagons in line, and others to lead them through the places which had previously been located as the most frequented by the locusts.

As night came on the bait kept moist, so that on the next day there were very few locusts throughout the region who did not find and devour a few flakes of bran. In this way a very efficient control was maintained and the cost sustained by the farmers was not great. The ingredients are usually bought in quantity and the results amply justify the time or money spent. The cost of this Kansas mixture as used in Canada in 1915 and 1916 was found to be 21 cents per acre, including all labour, so that it will be seen that the expense is not great for the results obtained. It has been found that from 4 to 5 lb. of this mixture to the acre is sufficient, provided it is properly prepared and distributed as evenly as possible over the ground. A larger quantity per acre or a larger percentage of Paris green will undoubtedly kill more locusts, but the cost is greater, and 4 to 5 lb. properly applied has given a thoroughly satisfactory control. Two applications of this standard formula would certainly give better results than one application of a stronger mixture. As a rule there is no need for more than one or two applications of bran mixture, but cases have been recorded in the United States where a big swarm of locusts on the range lands, having reduced the food on the ranges, move down to the crops in the valleys. In such instances it is necessary to keep a constant supply of the bait spread in a narrow strip along the edge of the range lands adjoining the cultivated crops in the valley. In this way all locusts crossing this control belt would come in contact with the bait and the majority would eat some of it. In spreading poisoned bait in a field it is not necessary to be very particular to cover every yard of ground, as the locusts, being very active insects, with a good sense of smell, will find it. They will come from 15 to 20 yards to bait placed in heaps, which shows that they can detect its presence from some way off. The effect of poison on the locusts is not observed at once, and it is usually from three to four days after they have eaten it before they die. This is with the Kansas formula as given; a stronger percentage of Paris green will act quicker, but is unnecessary, as the locusts eat little, if any at all, once they have the poison in their systems.

Where cultivated crops are being attacked in scattered localities, and not by a general migration from the range lands, it is almost always due to the fact that there are favourable breeding-grounds for the locusts in the immediate vicinity. The places most often chosen for oviposition are compact, firm lands, soft cultivated fields being avoided, as are also damp localities. The favourite places are rough, dry roadsides, dry banks, old dried-out pasture lands, and alfalfa-fields which have become hard and baked owing to the lack of proper attention. In these places the locusts will congregate for oviposition, and it will be from these places that the swarms will migrate to destroy the alfalfa and other cultivated crops in the immediate neighbourhood.

Ploughing.—These fields if they are being used as breeding-grounds should be ploughed up in the fall after the eggs have been deposited. This will break the egg-capsules and bury them, so that very few locusts will hatch out in the spring. If these places cannot be ploughed, a careful watch should be kept on them in the spring, and as soon as the young hoppers are seen to be emerging in large numbers control measures should be started. Poison bait can be scattered, at any rate, along the side of the ground next to the crops. A stream of water in an irrigation-ditch forms an effective barrier to the hoppers while they are small. Once the locusts become full-grown and are winged their control is more difficult. When the locusts are winged they may still be poisoned, but it is done more economically when they are younger and have not spread far from the grounds where they were hatched.

Hopperdozers.—Hopperdozers and hopper-catching machines are used extensively in many parts of the United States for controlling the locusts, both in the immature stages and also when they are winged adults. Hopperdozers were the first form of hopper-catching machines used and were mostly home-made, and naturally varied considerably in structure, but the description of one will serve for them all, as the differences were only in size and material used, and the ultimate results were in most cases equally efficient.

"The hopperdozer consists of a galvanized-iron pan mounted on low runners and having a backstop of canvas or sheet tin. The pan was usually made about 12 feet long by 2 feet wide and about 4 inches deep. The back and ends of the pan have a 2-inch flange, the front a 6-inch flange. This pan is supported back and front by a 2- by 4-inch which is set into the runners at either end, which are made of a 2- by 8-inch and are 4 feet long. The flanges are nailed to this wooden frame. A runner in the centre helps to strengthen the frame and support the pan. The hitch is made direct to the runners. A backstop 30 inches high, with triangular pieces for the ends, made of canvas or tin nailed on a frame, is held in position by allowing cross-pieces of the frame to fit into bow-irons on the back of the pan-frame, and this arrangement allows the backstop to be removed when not in use or if the machine is to be loaded into a wagon for removal from field to field. The pan when in use should have about 2 inches of water in it,

with a coating of coal-oil on the top. A movable frame forming partitions in the pan will greatly aid in keeping the liquid from slopping over too much. With machines of this sort catches of 8 to 10 bushels of hoppers have been collected in less than three hours. When the hoppers are too thick in the pan they may be removed with a tin scoop with holes in it, which will remove the hoppers and allow the water to drain back into the pan. From time to time the pan will want replenishing with water and oil. As this machine is drawn up and down the fields, the hoppers, jumping to avoid it, strike the backstop and fall into the water and oil, and those that succeed in jumping out again die, as the oil on their bodies is apparently fatal to them."

Hopper-catcher.—The most successful machine is the hopper-catching machine, which catches the hoppers alive, and has the advantage that it can be used on steep hillsides and rough ground where a hopperdozer with its pan of water and oil would be impossible, and the hoppers when caught form excellent chicken-food. It is not so easily made as the hopperdozer, but once made is far more economical to use. A description of this machine, which is given below, is taken from Bull No. 138 of the Utah Experimental Station, by E. D. Ball, 1915.

"This machine can be run over hay and grain crops, sugar-beets and potatoes; in fact, over practically everything except corn and ripening grain. The principle of the machine is very simple—a box about 2 feet square and 16 feet long on runners, a 2-foot by 4-inch extending out 4 feet at each end, to which a horse is attached. The horses then travel 24 feet apart, driving the grasshoppers in until most of them are in front of the 16-foot machine. A rope fastened to the hame on the inside of each horse and dragged just in front of the machine causes the hoppers to jump just as the machine gets to them. The front of the machine is made of tin and is about 2½ feet high and slightly curved. This front does not extend quite down to the bottom, and about 2 inches in front of it and about 4 inches high there is a false front, a second piece of tin, which curves back down and into the box. A grasshopper hitting the tin cannot get a foothold and is perfectly helpless and slides down between the two pieces of tin, strikes the curve, and is thrown well back into the box, far enough so that he cannot see the opening through which he entered. The top and back of the box are made of wire mosquito-netting and the hopper immediately jumps towards the light and clings to the netting, never seeking the hole through which he came in. Several bushels can be gathered in this way before they will shake down into the bottom sufficiently to choke up the front opening. As soon as this happens the front opening should be closed with gunny-sacks or similar material, and the hoppers can be shovelled out into sacks and used to feed chickens or dumped into a trench and buried. The material will cost between $8 and $9 and any one with a saw and hammer can make one in a very short time. The runners should be spaced to fit sugar-beet or potato-rows, if the machine is to be used on these crops. A machine if protected will last for years, and as it takes 24

feet at a sweep will cover 40 to 50 acres in a day, and will thus handle a large area. As there is no expense to the operation except a team and a man to drive, or preferably two small boys to ride the horses, the cost per acre is trifling. If the tin front is kept bright and shining the grasshoppers are apparently not able to see it at all and fly against it readily. From 6 to 10 bushels in an hour have been collected with one of these machines where the hoppers were numerous and conditions favourable, and 30 to 40 bushels per day taken from fields where they did not appear to be very abundant.

Other Machines.—Another form of hopper-catching device used in the States, principally against the migratory swarms of the pellucid locust (**Camnula pellucida**), is also described by E. D. Ball in the same bulletin, and as **C. pellucida** is one of the most destructive species which occurs in swarms from time to time in this Province, it may be of interest if I give Mr. Ball's description of the contraption known as the balloon hopper-catcher.

"The balloon consists of a light frame 12 feet long and 2 feet high, with two or three cross-bars to give it more rigidity. This frame has attached to it a bag, of which it forms the mouth and which tapers back to a point about 10 feet back of the frame. The point is open and when in use is fastened with a string tied round it like a sack is tied. In fact, a seamless sack makes a good point to this big bag. The bottom of the bag, which drags on the ground, is often made of heavy canvas, while the upper side is of ordinary sheeting. The frame is usually made of 1-inch by 4-inch stuff and the whole thing is drawn by a single light rope, which forks to the two ends and forks again to each corner. This rope is either fastened to the pommel of a saddle or else to a light whiffletree of a light harness. The pony is started off at a fast trot. The air inflates the open-mouthed sack, which 'balloons' up and draws along the ground, over the meadow-grass or grain-crop. The bottom of the frame draws along on the ground, and as a young hopper jumps to avoid it it slides under him, and as he jumps again and again each time he finds himself farther and farther back in the sack until he comes to rest with his fellows in the tip. The rider of the pony starts off at a good pace, swinging back and forth across the swarm until his sack has a bushel or so of grasshoppers in the apex. Then he dismounts and helps his partner to lift up the frame and shake all the hoppers back into the apex of the sack; then another sack is held over the end, the string untied, and the hoppers sacked. Where the ground is rough the lower side of the frame catches and the top flops over and closes the mouth. To obviate this a rope is fastened to the top of the frame and a small fence-post is drawn along back of the sack, thus serving to pull the top back and keep the mouth open. Practically all the wear comes on the bottom of the sack, so this is made of heavier material, or, better still, a second strip is fastened to the frame and draws underneath the sack and protects it from injury. Old binder-canvas and such material make excellent material for this use."

In dealing with **Camnula pellucida**, which has the habit of congregating in a few concentrated areas for oviposition, although the adults may be scattered over large tracts of land, there are several methods of control which have been practised in the States. The limits of the breeding-grounds must be carefully ascertained during the egg-laying season, and this area may then be ploughed, if ploughing is possible. A trench may, further, be dug around the area, into which the tiny hoppers will fall when they begin to migrate, which they do as soon as hatched, hopping always towards the sun instead of remaining close to their egg-capsules, which is the case with most of the other species. If this trench can be flooded from some irrigation-ditch it will be still more effective. In some cases where the breeding-grounds are flat and hard, rollers have been employed and the ground gone over every two or three days during the period when the hoppers are hatching, as this species hatches in great numbers at one time, usually within a week or ten days. The young hoppers have also been sprayed at this time with oil. This proves a very expensive though effective method. Once the hoppers have left the breeding-grounds and are advancing in swarms they may be caught with the balloon catchers. **Camnula pellucida** is not easy to poison, as it is on the move most of the time, swinging about on their course, although the general tendency is to travel in a south and south-westerly direction following the sun. During these migrations the locusts never turn aside on account of food, and will pass through a field of alfalfa or grain, eating the plants in their course completely off, even eating down to the roots below the level of the ground, but leaving the rest of the field untouched. According to E. D. Ball, "If a swarm comes to a body of water, or even an irrigation-ditch, they will pile up against the bank and stay there for a long time, travelling up and down the bank as the sun swings round, but not turning aside or going back."

This habit of **Camnula pellucida** of travelling in compact swarms and always toward the sun has been observed by many writers in the United States and described in their bulletins. From my limited observations and from accounts given to me by people who have observed **Camnula pellucida** in British Columbia, I do not think that this habit is at all common in this Province. While this species certainly seems to keep together in swarms, more than do the species of **Melanoplus**, and these swarms travel from place to place, the tendency is to travel from the hatching-grounds to lower levels, where the feed is greener, while immature, and to return to the highest hill-tops for oviposition. There is apparently no tendency to travel toward the sun in this Province rather than away from it, the direction of travel being determined mostly by the position of the available food and the slope of the ground.

NATIVE FLOWERS FOR BEES.

By J. Davidson, F.L.S., F.B.S.E., Botanist in Charge of the Herbarium and Botanical Gardens, University of B.C.

Numerous requests from residents in various parts of the Province for assistance in the identification of "honey-yielding" plants, and for information regarding the native flora of regions where settlers proposed to establish apiaries, prompted me to select "Native Flowers for Bees" as a subject for discussion before this Society, in response to the request of the Secretary.

As the bee-keeping industry is a comparatively new one in this Province, bee-keepers here have to depend largely on the experience of apiarists in other Provinces or in the United States, and British Columbia apiarists are finding many interesting problems, due largely to the fact that our climatic conditions and native flora are quite different from those of the Eastern Provinces and for most of the States in America. Further, in British Columbia we have such a variety of habitats, from the moist Coast area with luxuriant vegetation to the arid Interior with an almost desert flora, and again to the moist regions of the Interior and the foot-hills of the Rockies, in all of which the soil, the rainfall, the growing season, the extremes of temperature, and the resultant effect of these on the flora show corresponding differences which make it necessary for the prospective apiarist to study local conditions and be guided by his observations.

The relationship between the local flora and the success or failure of apiarist cannot be disputed. You can have no more bees than the flora will support; apart from insect parasites, the flora is the limiting factor. Bees, being the only insects which feed their offspring with pollen, are wholly dependent upon flowers for their own food and that of their offspring.

One need not here enter into the discussion of the relationship between the habits of bees and the structure of flowers, further than to mention that without our native bees this Province would be minus many of our showy wild flowers, for as pollinating agents the bees far surpass all other insects in importance. So dependent are many flowers on the visits of bees that in their absence they fail to produce seed, as is well known in the case of red clover, salvia, larkspur, and some orchids. You probably know that when the farmers of New Zealand first grew red clover it failed to produce seed because there were no bumble-bees in New Zealand, and it was not until several species of these were introduced from Great Britain that the raising of clover-seed became commercially profitable. The bee-keeper is similarly indebted to many species of wild or native bees for the abundance of flowers which he depends upon to replenish his apiary from year to year.

About fifteen years ago Lord Avebury advanced a theory that blue flowers were mostly favoured by bees, and numerous examples given made the theory seem very plausible. It has since been shown that structure, and perhaps odour, is of greater importance than colour, because different coloured varieties of asters, zinnias, and centaureas are visited indiscrimi-

nately, whereas many of the best bee-flowers are not blue. For example, we find amongst the best native bee-plants of this Province, **Salix** (willows), **Solidago** (goldenrod), **Cleome** (Rocky Mountain bee-flower), **Taraxacum** (dandelion), **Helianthus** (Sunflowers), and **Monarda** (horsemint), none of which have blue flowers.

Regarding the structure of flowers best suited for bees, one has to take into account the different species of bees in each region, as we find a great variation in the length of their tongues according to species and sex, varying from 6 or 7 mm. in the case of honey-bees to about 20 mm. in some species of bumble-bees. Flowers, therefore, with the nectar at a greater depth than 6 or 7 mm. are of little value to the apiarist, and very shallow flowers may be classed in the same category, because flies and other insects with very short tongues may reach the nectar and thus limit the supply available for bees.

It has been calculated that about 37,000 loads of nectar are required for the production of 1 lb. of honey; it is therefore necessary for the bee to get as much as possible from each flower, and the flowers most favoured by honey-bees are those with a short narrow tube which will prevent smaller insects from reaching the nectar.

We do occasionally find honey-bees visiting flowers with long spurs and obtaining nectar through holes made in the spurs by bumble-bees. This dishonest method of obtaining the nectar seems very prevalent not only on this continent, but also in Europe. In the north of Scotland I have examined hundreds of wild dog-violets and every one had its spur perforated; in other years on the same area I have scarcely found a damaged spur. In British Columbia one frequently finds the Columbine spurs similarly pierced, and it has been reported that about 300 different species of flowers are thus robbed.

Though I have never seen a bumble-bee in the act of burglary, I learn from other observers that the punctures are made by laciniæ, or lance-shaped ends of the maxillæ. I am not aware of any authentic case of a honey-bee thus robbing the flower of its nectar where the flower has not previously been perforated by bumble-bees.

ALL BEE-FLOWERS DO NOT YIELD NECTAR.

There are other native plants, however, which yield no nectar, yet are valuable to bees as sources of pollen to feed the young larvæ. Apiarists generally distinguish between the pollen-yielding and the nectar-yielding flowers, but many novices overlook the importance of this distinction, and one cannot always rely on what novices write in prose or poetry. For example, the wild roses, of which we have so many in British Columbia, are nectarless, but useful in providing an abundance of pollen which bees make free use of. A poet, observing the frequent visits of honey-bees to roses, bursts into song in the following words:—

> *He* harries the ports of the hollyhocks
> And levies on poor sweetbrier;
> And drinks the whitest wine of phlox,
> And the rose is his desire.

"*He*" must refer to drones, and not to the undeveloped females or workers which visit the flowers. The tube of the phlox is too long for the tongues of honey-bees; the poet may have seen a long-tongued bumble-bee without knowing the difference, and phlox is generally regarded as a butterfly-flower; had the poet known the rose was nectarless we would have lost this gem of ignorance.

In dealing with the different kinds of native plants for bees, it may be useful to indicate whether they yield nectar or pollen, or both.

Willows.—Probably the most valuable plants to the apiarist are the willows; they furnish the first nectar of the season, and honey-bees have been reported as storing from 8 to 15 lb. of honey per hive from this source alone. The honey has a pleasant aromatic taste, not unlike that obtained from fruit-blossoms. Further, no other early blooming flowers yield so much pollen as the willows, as any one can prove by watching the myriads of bees returning with heavily laden pollen-baskets from almost any clump of willows in the early spring.

The willows are well distributed over the Province, different species in different districts, but in the Coast region (i.e., west of the Coast Range) we have in succession Nuttall's, Scouler's, Sitka, Hooker's, and the cracked-bark willow, the four former probably being the most productive.

As willows are readily grown from twigs stuck into moist soil, they can be easily multiplied, or introduced into districts where they are scarce. It should be borne in mind, however, that in areas infested with tent-caterpillars willows are favourite food-plants of this pest.

Dandelion (**Taraxacum officinale**).—Though one cannot consider this a native plant, it is so closely associated with man that in practically every little community it is found as an introduced weed which has come to stay and cause us endless trouble trying to eradicate it from our lawns and gardens. "It's an ill wind that blaws naebody guid," and the wind that blows the dandelion fruits in the direction of an apiary should be appreciated by bee-keepers. The dandelion's chief value lies in providing pollen and nectar for building up colonies in early spring just after the willows have passed their best. It is not relied on to provide a surplus of honey, though in occasional years bees will store a surplus from this source. The honey is of an amber colour.

Cleome serrulata, sometimes known as spider-flower, is known to bee-keepers in Colorado as the Rocky Mountain bee-flower on account of the abundance of nectar which it furnishes. This plant is found in the Okanagan and Chilcotin Districts, though not perhaps in such quantities as to make its presence noticeable to bee-keepers. It should not be difficult, however, to encourage, and as it is one of our showy species it will prove an acquisition to the flora of any district. Under favourable conditions it is reported a heavy yielder, two or three flowers giving a full load of nectar for honey-bees.

Goldenrod (**Solidago,** various species) is a widely distributed plant in British Columbia, some species being more common in the Coast area and

others more common in the Interior; the different species are so like each other that amateurs overlook their differences and regard them merely as goldenrods. It has been found, however, that bees prefer certain species, and will fly over several plants of one species to visit another one. I shall be glad at any time to receive specimens of the goldenrods most favoured by honey-bees, so that we can ascertain the species of most value to British Columbia apiarists.

The honey from this source is described as of a golden-yellow, with heavy body, not of the finest flavour, and the fall honey when freshly gathered is said to have such a pronounced odour that it can be detected a little distance from the hive.

Asters (many species), like the goldenrods, are well distributed over the Province, and it is possible that much of the value credited to goldenrod belongs to the asters, because the former are most conspicuous. The later flowering species are considered of most value.

Blooming, as they do, in the fall until frost cuts them down, asters are valuable in providing winter stores; though aster-honey is not considered good for this purpose it is in most localities mixed with dark fall honey, so that it is rarely stored separately. The honey is pale amber, with a mild flavour, is rather thin, and by itself does not thicken up readily.

Horse-mint (**Monarda fistulosa**) is a plant which, like red-clover, varies in value according to the locality in which it grows. Of the ten species of **Monarda**, three are recommended to United States apiarists, the best of which is our native species common in some parts of the Okanagan Valley, but somewhat limited in its distribution. The corolla-tubes are sometimes very deep and one would scarcely think honey-bees could reach the nectar; nevertheless, in hot dry regions it is considered of major importance and it is widely reported as a source of honey.

Milkweed (**Asclepias**) is to the botanist a plant of unusual interest on account of the peculiar adaptation it has for insect pollination. The stamens are so placed and constructed that when an insect visits the flower the pollinia, or masses of pollen, adhere to its body and sometimes its feet, and lurid word pictures have been printed of bees becoming so entangled as to be unable to find their way home again, but these are probably exaggerated.

In "Gleanings in Bee-culture" for July, 1912, an apiarist reports a yield of 1,320 lb. of honey from eleven colonies in eleven days from milkweed. Any plant that will yield from 10 to 11 lb. of honey per colony per day deserves encouragement. The honey is light in colour and of good quality.

Dogbane (**Apocynum**) is often erroneously called milkweed because, like many other plants, it exudes a milky juice when injured. This plant is found at the Coast and in the Interior, where it more abundant. (It was formerly of great value to the Indians for the production of fibre for lines.) It is very common in the Kootenay, Okanagan, and Thompson Valleys, but appears in many unexpected places in the Coast area and on the islands along the Coast, including Vancouver Island. Although not usually listed amongst honey-yielding plants, I was glad to learn from Mr.

W. Sheppard, Provincial Apiarist for the Kootenay region, that this plant was considered a valuable bee-plant in his district.

In addition to the foregoing useful bee-plants, we have in some parts of the Province, particularly in the Lower Fraser Valley and on some parts of Vancouver Island, a plant which is considered an agricultural undesirable —namely, the bitterweed, or sneezeweed (**Helenium**). Though I have not heard of our native species affecting the quality of honey, I draw attention to it in the hope of eliciting information as to whether or not it is as harmful as its closely related species found in the United States.

Regarding **Helenium tenuifolium** in Texas, it is reported that the "honey yield is good in favourable seasons; honey golden-yellow, heavy body, but very bitter, as if 50 per cent. quinine and some pepper were added." Our native species flowers from June to August, and I have seen it in abundance around Langley Prairie and on Vancouver Island in the vicinity of Colwood.

If apiarists have had experience with bitter honey, we would like to know in order to ascertain if other plants may be responsible for similar results. Good crops of white-clover honey are frequently spoiled in the United States by mixing with bitter honey.

Pammel, in his huge work on poisonous plants, reports that the honey from rhododendron and **Kalmia latifolia** is poisonous, and mentions our native species, **Kalmia polifolia**, as possessing similar properties. This is of interest to us, because in some districts we have large areas covered with these plants. There are probably no apiarists within reach of our evergreen rhododendron region in the Skagit River basin, but we may have in the regions of white rhododendrons, and there must be some within reach of the bogs which are ablaze in spring with millions of our beautiful kalmia flowers.

Conclusive evidence seems to be lacking as to the poisonous properties in the nectar of these plants, and it is hoped that by mentioning it here it may lead to our being able to corroborate or contradict the statement with definite proof.

As previously mentioned, this work in British Columbia is comparatively new; there is much to be done in testing the value of our native flowers for bees. With keen and intelligent observers in various parts of the Province co-operating in this work, we should be able to accumulate much valuable information for the benefit of the present and future generations. Entomologists can assist, if they will, by observing flowers that are visited by honey-bees, and having the flowers correctly identified so that definite records can be made.

It is impossible here to deal in detail with all the native plants known to yield nectar and pollen for bees. I have drawn up a list of over 100 botanical and common names of the best known species, indicating their use for nectar or pollen, or both, and the periods of flowering.

The list is not by any means to be regarded as complete, but is submitted as a nucleus to be revised or added to according to the experience of apiarists working under British Columbia conditions.

It is quite likely that some species will be of value to apiarists at the Coast, though the same species may be unimportant in the Interior, and vice versa.

I have referred chiefly to native plants; the value of fruit-trees, clover, alfalfa, and other introduced plants is well enough known, and the abundance of these depends on the number of farms and orchards in the district.

The main point of economic importance is that this Province uses more honey than it produces; whereas, with the assistance of our native bee-flowers, we should be able to produce more than we use and have a surplus to export. If the study of our native flowers can assist the apiarists to attain this end, the Department of Botany of the University is ready to co-operate by assisting in the identification of likely bee-plants, so that our present information may be verified or added to, and the results made known to apiarists in other parts of the Province, and thus contribute to the future prosperity of British Columbia.

(This address was illustrated by herbarium specimens of the plants mentioned.)

LIST OF PLANTS.

Name.	Use.		Period of Flowering.								Remarks.
	Nectar.	Pollen.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	
1. Acer	X	X	....	X	X	X	....	....	....	....	
2. Alder (*see* No. 3)	....	X	....	X	X	X	....	....	....	....	
3. Alnus	....	X	....	X	X	X	....	....	....	....	
4. Amelanchier	X	....	....	....	....	X	X	....	....	....	
5. Apocynum	X	....	....	....	....	....	X	X	....	....	
6. Arctostaphylos Uva-ursi	X	....	....	....	....	X	....	....	....	....	
7. Arctostaphylos tomentosa	X	....	....	....	X	X	....	....	....	....	Honey, amber; excellent flavour.
8. Arbutus	....	....	....	....	....	....	X	....	....	....	
9. Asclepias	X	....	....	....	....	....	....	X	....	....	Very valuable in some localities.
10. Aster	X	....	....	....	....	....	....	X	X	X	
11. Barberry (*see* No. 14)	X	....	....	X	X	X	....	....	....	....	
12. Bearberry (*see* No. 6)	X	....	....	....	....	X	....	....	....	....	
13. Beggarticks (*see* No. 16)	X	....	....	....	....	....	....	....	X	X	Honey, amber; heavy body; granulates slowly.
14. Berberis	X	....	....	....	X	X	X	....	....	....	
15. Betula	....	X	....	....	X	X	....	....	....	....	
16. Bidens	X	....	....	....	....	....	....	....	X	X	Honey, amber; heavy body; granulates slowly.
17. Birch (*see* No. 15)	....	X	....	....	X	X	....	....	....	....	
18. Bird-cherry (*see* No. 81)	....	....	....	....	....	X	X	....	....	....	
19. Blackberry (*see* No. 90)	X	....	....	....	X	X	....	....	....	....	Honey similar to that from raspberry.
20. Blueberry (*see* No. 107)	X	X	....	....	X	X	X	....	....	....	
21. Bucklush (*see* No. 27)	X	X	....	....	....	X	X	X	....	....	
22. Buckthorn (*see* No. 85)	X	....	....	....	....	X	....	....	....	....	Honey, dark; does not granulate.
23. Cactus (*see* No 76)	....	....	....	....	....	....	X	X	....	....	
24. Canada thistle (*see* No. 31)	X	....	....	....	....	....	X	X	....	....	Gives good honey.
25. Cascara (*see* No. 85)	X	....	....	....	....	X	....	....	....	....	Honey, dark; does not granulate.
26. Catnip (*see* No. 74)	X	....	....	....	....	....	X	X	....	....	Not important.
27. Ceanothus spp	X	X	....	....	....	X	X	X	....	....	
28. Choke-cherry (*see* 81)	X	....	....	....	....	X	....	....	....	....	
29. Chicory (*see* No. 30)	....	....	....	....	....	....	....	X	X	X	
30. Cichorium	X	....	....	....	....	....	....	X	X	X	
31. Cirsium spp	X	....	....	....	....	....	X	X	....	....	
32. Cleome	X	....	....	....	....	....	....	X	....	....	Heavy yielder.
33. Clematis	....	X	....	....	....	....	....	X	....	....	
34. Cockle-bur (*see* No. 113)	....	X	....	....	....	....	X	X	X	....	
35. Cornus	....	....	....	....	X	X	X	....	....	....	
36. Crab-apple (*see* No. 82)	X	....	....	....	X	X	....	....	....	....	
37. Crataegus	X	X	....	....	....	X	X	....	....	....	
38. Dandelion (*see* No. 106)	X	X	....	....	X	X	....	....	....	....	Honey, amber.
39. Dogbane (*see* No. 5)	X	....	....	....	....	....	X	X	....	....	
40. Dogwood (*see* No. 35)	....	....	....	....	....	X	X	X	....	....	
41. Epilobium	X	....	....	....	....	....	X	X	X	....	A heavy, reliable yielder.
42. Figwort (*see* No. 95)	....	....	....	....	....	....	X	....	....	....	Nectar abundant.
43. Firewood (*see* No. 41)	X	....	....	....	....	....	X	X	X	....	
44. Gaultheria	X	....	....	....	....	....	X	X	....	....	
45. Goldenrod (*see* No. 98)	X	....	....	....	....	....	....	....	X	X	
46. Gooseberry (*see* No. 88)	X	X	....	....	X	X	....	....	....	....	
47. Hawthorn (*see* No. 37)	X	X	....	....	....	X	X	....	....	....	
48. Helianthus	X	....	....	....	....	....	....	X	X	....	Nectar often abundant.
49. Honeysuckle (*see* No. 57)	X	....	....	....	X	X	X	....	....	....	Short-tubed species locally important.
50. Horehound (*see* No. 63)	X	....	....	....	....	....	X	X	....	....	Honey, dark amber; strong flavour.
51. Horse-mint (*see* No. 70)	X	....	....	....	....	....	X	....	....	....	Honey, amber; flavour somewhat strong.
52. Huckleberry (*see* No. 109)	X	....	....	....	X	X	X	....	....	....	
53. June-berry (*see* No. 4)	X	....	....	....	X	X	....	....	....	....	
54. Kalmia	X	....	....	X	X	X	....	....	....	....	
55. Kinnikinnik (*see* No. 6)	X	....	....	....	....	X	....	....	....	....	
56. Locust (*see* No. 91)	X	....	....	....	....	X	X	....	....	....	Honey, white; fine flavour.
57. Lonicera	X	....	....	....	X	X	X	....	....	....	Short-tubed species locally important.
58. Lupine (*see* No. 59)	....	X	....	....	X	X	X	....	....	....	
59. Lupinus	....	X	....	....	X	X	X	....	....	....	
60. Madrona (*see* No. 8)	....	....	....	....	....	....	X	....	....	....	
61. Manzanita (*see* No. 7)	X	....	....	....	X	X	....	....	....	....	Honey, amber; excellent flavour.
62. Maples (*see* No. 1)	X	X	....	X	X	X	....	....	....	....	

LIST OF PLANTS—*Continued.*

Name.	Use.		Period of Flowering.								Remarks.
	Nectar.	Pollen.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	
63. Marrubium	X	...	...	...	...	...	X	X	...	...	Honey, dark amber; strong flavour.
64. Meadow-rue (*see* No. 107)	...	X	...	...	...	X	X	...	...	...	
65. Melilotus alba	X	...	...	...	...	...	X	X	X	X	Honey, slightly green; cinnamon flavour.
66. Mentha	X	...	...	...	...	...	...	X	X	...	Honey, amber.
67. Michaelmas daisy (*see* No. 10)	X	...	...	...	...	...	...	X	X	X	
68. Milkweed (*see* No. 9)	X	...	...	...	...	...	X	...	...	...	Very valuable in some districts.
69. Mint (*see* No. 66)	X	...	...	...	...	...	...	X	X	...	Honey, amber.
70. Monarda	X	...	...	...	...	...	...	X	...	...	Honey, amber; flavour somewhat strong.
71. Mountain-laurel (*see* No. 54)	X	...	...	X	X	X	...	...	...	...	
72. Mullein (*see* No. 110)	...	X	...	...	...	...	...	X	X	...	
73. Myrica	...	X	...	X	X	...	...	...	...	...	
74. Nepeta Cataria	X	...	...	...	...	...	...	X	X	...	Not important.
75. Oak (*see* No. 83)	...	X	...	...	X	X	...	...	...	...	
76. Opuntia	...	...	...	...	...	...	X	X	...	...	
77. Oregon grape (*see No.* 14)	X	...	...	...	...	X	...	...	...	...	
78. Polygonum	X	...	...	...	...	...	...	X	X	X	
79. Poplar (*see* No. 80)	...	X	...	...	X	...	...	...	...	...	
80. Populus	...	X	...	...	X	...	...	...	...	...	
81. Prunus spp	X	...	...	...	...	X	X	...	...	...	
82. Pyrus	X	...	...	...	...	X	X	...	...	...	
83. Quercus	...	X	...	...	X	X	...	...	...	...	
84. Raspberry (*see* No. 90)	X	...	...	...	...	X	X	X	...	...	Flavour unsurpassed.
85. Rhamnus	X	...	...	...	...	X	...	...	...	...	Honey, dark; does not granulate.
86. Rhodendron	X	...	...	...	...	...	...	X	...	...	
87. Rhus glabra	X	...	...	...	...	...	X	X	...	...	
88. Ribes spp	X	X	...	...	X	X	...	...	...	...	
89. Rocky Mountain Bee-plant (*see* No. 32)	X	...	...	...	...	...	X	...	...	...	
90. Rubus spp	X	...	...	...	...	X	X	...	...	...	Reliable when abundant.
91. Robinia	X	...	...	...	...	X	X	...	...	...	Honey, white; fine flavour.
92. Rosa spp	X	X	...	...	...	...	X	...	...	...	
93. Salal	...	...	...	...	...	...	X	X	...	...	
94. Salix spp	X	X	X	X	X	...	...	...	...	...	Nectar abundant.
95. Scrophularia	X	...	...	...	...	...	X	...	...	...	
96. Smartweed (*see* Nos. 7, 8)	...	...	...	...	...	...	...	X	X	X	
97. Snowberry (*see* No. 105)	X	...	...	...	...	...	X	X	...	...	
98. Solidago spp	X	...	...	...	...	...	...	X	X	...	Honey, golden-yellow; not finest flavour.
99. Sonchus	X	...	...	...	...	...	X	X	...	...	
100. Sow-thistle (*see* No. 99)	X	...	...	...	...	...	X	X	...	...	
101. Sumac (*see* No. 87)	X	...	...	...	...	...	X	X	...	...	Honey, amber; fine flavour.
102. Sunflower (*see* No. 48)	...	...	...	...	...	...	...	X	X	...	Nectar often abundant.
103. Sweet clover (*see* No. 65)	X	...	...	...	...	...	X	X	X	X	Honey, slightly green; cinnamon flavour.
104. Sweet gale (*see* No. 73)	...	X	...	X	X	...	...	...	...	...	
105. Symphoricarpus	X	...	...	...	...	...	X	X	...	...	
106. Taraxacum	X	X	...	...	X	X	...	...	...	...	
107. Thalictrum	...	X	...	...	...	X	X	...	...	...	
108. Thistles (*see* No. 31)	X	...	...	...	...	...	X	X	...	...	
109. Vaccinium spp	X	...	...	...	X	X	X	...	...	...	
110. Verbascum	...	X	...	...	...	...	...	X	X	...	
111. Willow-herb (*see* No. 41)	X	...	...	...	...	...	X	X	X	...	
112. Willows (*see* No. 94)	X	X	X	X	X	...	...	...	...	...	
113. Xanthium	...	X	...	...	...	...	X	X	X	...	

THE IMPORTANCE OF MOSQUITOES, WITH NOTES ON SOME BRITISH COLUMBIA SPECIES.

By E. Hearle.

Mosquitoes are responsible for half the entire mortality of the human race. This is due to their position as the transmitters of malaria alone, according to Dr. Creighton, the noted authority on that disease. The mosquitoes of the tropics "have their spears poisoned with death-dealing disease-germs" and do not fight a clean warfare as do their northern relations. They and their accomplices have played a great part in moulding the destiny of the world. The fertile plains of Africa might have been the centre of the world's civilization; but, instead, the deadly swarms of mosquitoes and the malaria carried by them have shut off Africa more effectively than the greatest natural barriers could have done. When one realizes the terrible proportions assumed by malaria, yellow fever, dengue, and filariasis in many parts of the tropical world, and that these diseases are transmitted solely by mosquitoes, it is evident that Dr. Creighton's statement is by no means extravagant. India alone lost 5,000,000 people in one year from malaria.

In temperate and northern countries mosquitoes exert a very important economic influence in many districts. They do not, it is true, invoke the aid of that dread ally, disease; but their own spears are weapons enough with which to wage a terrible warfare. In some areas the bloodthirsty hordes occur in such enormous numbers that progress and development are retarded and life is made intolerable for man and beast. Much of New Jersey was thus effected, and in the 1917 Report of the Department of Conservation and Development the Board states that it "is convinced that the salt-marsh mosquitoes, more than anything or than all else, are responsible for the backwardness of the eastern and southern sections of the State. They have depopulated farms, prevented the growth of towns, hampered the development of shore resorts, and restricted the extension of suburban communities."

A most exhaustive study of the mosquitoes of New Jersey has resulted in the adoption of control measures which, wherever thoroughly carried out, have greatly relieved the situation. Every district has its own particular problem, usually intimately associated with peculiarities of topography and special advantages offered to one or more species in the mosquito fauna. In New Jersey the big problem lay in the salt marshes. At the high tides the flooding of these resulted in the formation of shallow pools where the salt marsh mosquitoes, **Ædes sollicitans, Ædes cantator,** and **Ædes taeniorhynchus,** could develop unmolested by their natural enemies, mainly certain fishes. By drainage the conditions so favourable to mosquito-development were eliminated. Where complete drainage was not practicable, ditching was undertaken in such a way that the controlling fishes could penetrate to all breeding-places.

Flooded meadow at Mission. A typical breeding-place of *Aedes sylvestris*.

In various parts of Canada we have mosquito problems which in some cases are almost as serious as that of New Jersey. In Northern Quebec and Ontario, in areas on the East Coast, on the Prairies, in parts of British Columbia and in the North-west Territories mosquitoes at times assume considerable economic importance.

The mosquito problem of the Fraser Valley, British Columbia, is one of the most serious economic factors presented in that district. Agriculture is seriously affected; at times much of the small fruit is lost owing to the difficulty of obtaining pickers; cattle become very emaciated, and on dairy-farms the drop in milk production is marked during years when mosquitoes are troublesome; while calves have actually been killed by them. In exceptionally bad seasons lumber camps and mills have been obliged to close down.

The Dominion Government is undertaking an investigation of the problem, and the writer, under the direction of Dr. C. Gordon Hewitt, the Dominion Entomologist, was engaged during the past summer as a student of the Honorary Research Council in making a preliminary survey of the district and of the species involved. The following notes are taken from a report to the Dominion Research Council: Nineteen species were taken in the Lower Fraser Valley; but only two, **Ædes aldrichi** and **Ædes sylvestris,** were found to be of any great importance. During years when weather conditions cause the rapid and extended melting of the snow on the mountains the Fraser River overflows its banks and floods the surrounding alder bottoms and open flats. This provides ideal conditions for the extensive development of the two species which are responsible for nearly all the mosquito trouble of the district.

SOME MOSQUITOES OF THE LOWER FRASER VALLEY, B.C.

Ædes aldrichi Dyar and Knab. This, the dominant Fraser Delta mosquito, breeds extensively along the river wherever alder bottoms are flooded. This is the first record for Canada, although the species has previously recorded from Idaho and Montana.

Ædes sylvestris (Theobald) Dyar and Knab. A very common Fraser Valley mosquito. It occurs in great numbers wherever the river floods open flats and meadows.

Ædes varipalpus Coquillett. A very beautiful black-and-white mosquito which is fairly common in wooded areas. It is a tree-hole breeder, although occasionally larvæ may be taken in artificial receptacles. The males as well as the females are attracted to the person, although they cannot bite.

Ædes punctor Kirby. This is a fairly common but very localized species. It is restricted to woods, especially those that are dark and gloomy. The larvæ breed in shallow temporary woodland pools.

Ædes cinereus Meigen. This small red-brown species occurs generally throughout the Fraser Valley. Although at times they bite viciously, they are seldom troublesome and never leave the vicinity of their breeding-places. The larvæ are found in shallow, protected surface pools and alder-swamps.

Ædes curriei Coquillett. This species was found only along the Coast and on the outlying islands. It breeds in rock pools filled with brackish water and on salt-marshes. Although a bad biter, it is seldom sufficiently abundant to be troublesome.

Ædes canadensis (Theobald) Dyar and Knab. This is essentially a woodland species, and, although only one specimen was taken during the past season, it may be fairly prevalent in certain localities when the climatic conditions are satisfactory.

Culex saxitilis Grossbeck. This small, dark, inoffensive mosquito is found very generally throughout the district. The larvæ are found mainly in surface pools and ditches, especially those protected by willow or other growth. The adults are not known to attack warm-blooded animals.

Culex tarsalis Coquillett. This species is found in small numbers through the Fraser Valley. It is fortunate that it does not occur more abundantly, as it is one of the worst biters and is very insistent in its efforts to enter houses. The larvæ are found in roadside ditches, surface pools, and alder and open swamps.

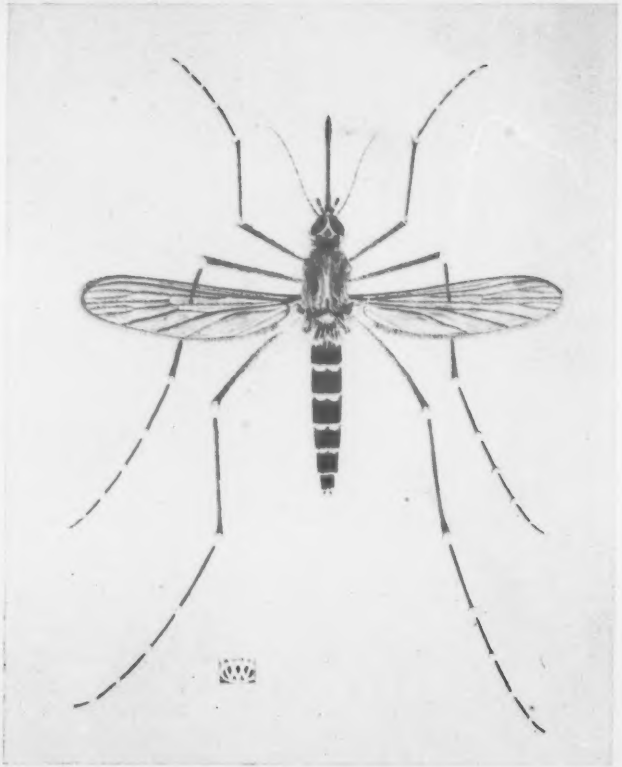
Culex pipiens Linnæus. In spite of the fact that conditions very favourable to the development of **C. pipiens** occur throughout the valley, specimens were taken only in Vancouver. This limited distribution indicates a very recent introduction, and it will be interesting to follow the spread from this point. **Culex pipiens** is one of those domesticated mosquitoes which have managed to spread far and wide through shipping. Like the English sparrow, they thrive exceedingly wherever introduced.

Culiseta incidens (Thompson) Felt. This is one of the largest of British Columbian mosquitoes and one of the most inoffensive, as it is so timid that it will seldom bite. It is the most generally distributed species in the district—almost every rain-water barrel is teeming with larvæ throughout the summer. Although rain-water barrels provide the main breeding-places, the larvæ are by no means particular, and were taken in alder-swamps, ditches, and roadside pools, and even in brackish water in company with **Ædes curriei.**

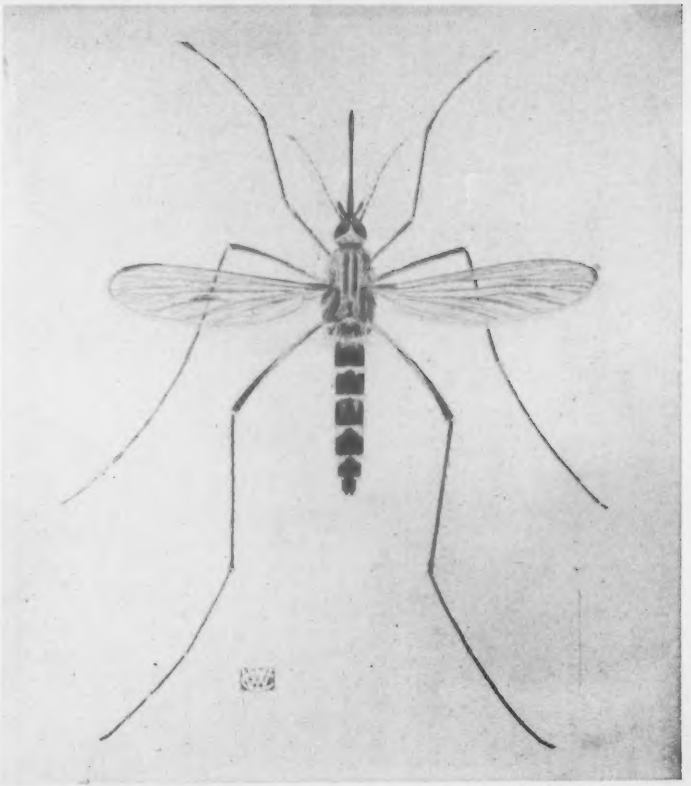
Culiseta impatiens (Walker). This is another very large mosquito. It is found mainly in thinly wooded areas and on mountain-slopes. Usually it is too timid to be troublesome, but at times it will attack with some determination. This species is the one commonly known as the snow-mosquito, from its habit of leaving hibernation quarters on warm days during the winter.

Culiseta alaskænsis (Ludlow). Only one specimen was taken. This was obtained on May 20th at Hope.

Mansonia perturbans Walker. This is a very interesting species. The larvæ and pupæ do not come to the surface, but attach themselves to the submerged stems of water-plants, from which they will obtain the necessary oxygen. As the bite of this species is more painful than that of any other North American mosquito, it is fortunate that it is comparatively rare. Specimens were taken in numbers only in certain areas in Stanley Park, Vancouver.



Ædes sylvestris Dyar & Knab.



Ædes aldrichi Dyar & Knab.

Original drawings by C. W. Young.

Anopheles punctipennis Say. Although not common during 1919, this species may be fairly abundant during wet seasons. The larvæ occur almost everywhere throughout the district in roadside ditches, surface pools, and alder swamps.

Anopheles occidentalis Dyar and Knab. This anopheline is found sparsely throughout the district. The larvæ occur mainly in roadside ditches and alder-swamps.

Several species of **Ædes** were also taken in the Fraser Valley, the identity of which could not be determined with certainty on account of the scantiness and condition of the material obtained. Dr. Dyar kindly examined these and reported on them as follows: **Ædes fletcheri** or **riparius**; **Ædes excrucians** or **fitchii.**

The writer desires to express his thanks to Dr. H. G. Dyar for his kindness in verifying his findings and for determining the identity of **Ædes punctor** and **Culiseta impatiens.**

A FURTHER REVIEW OF APPLIED ENTOMOLOGY IN BRITISH COLUMBIA.

BY R. C. TREHERNE, ENTOMOLOGIST IN CHARGE FOR B.C. DOMINION DEPARTMENT OF AGRICULTURE.

Notable progress has been made in applied entomology during the past six years. The disastrous war in Europe between 1914 and 1918 undoubtedly checked progress to a marked extent, and many entomologists who assisted so materially in establishing our science during its early years in British Columbia will not return. Some lost their lives in France; others who enlisted for the Empire's service, but who survived, have found their billets in other industries in other parts of the world. The campaign for greater production which was carried on industriously during the middle years of the war undoubtedly proved a leading string to foster the development of economic entomology. The closing of the avenues of loss on the farm proved a great incentive to popularize entomology. Farmers, some for the first time, have learnt to realize the serious inroads insect pests are capable of causing in their financial returns. The improved prices for agricultural commodities of recent years also has acted as an impetus towards providing better equipment for fighting agricultural pests, and this same feature has induced growers to take a wider interest in life-histories and modes of combat of our injurious insects.

During the years 1914 and 1915 the names of those engaged in economic-insect investigations numbered three or four. To-day, or rather during the season of 1920, there were twelve individuals who have been actively engaged in solving economic-insect problems. It is true that the majority of these investigators commenced their work in the last two years or since the termination of the European war, and it is pleasing to note that

fully half the number are men who have seen active service at the Front. If the progress shown during the past two years is continued, the outlook for our science is bright indeed. I propose mentioning briefly the progress of entomology in the Province for the past few years on the supposition that our historical notes may become confused with the wealth of data we expect to appear in the near future.

During 1914 the writer, who had charge of the Dominion Entomological Laboratory and Field Station at Agassiz, published Bulletin No. 8 of the Dominion series on the strawberry-root weevil. This publication was based on studies carried on at Hatzic during 1912 and 1913. It is interesting to note that this bulletin was the last to appear as an Entomological Division bulletin of the Experimental Farm system. The formation of the Dominion Entomological Branch as a separate Department under the Dominion Department of Agriculture took place under the ægis of Dr. C. Gordon Hewitt on February 26th, 1914. During the summers of 1914 and 1915 the writer was engaged in a study of the cabbage-root maggot, the wheat-midge, and other insects of local interest in the Lower Fraser Valley.

All entomological investigation up until the close of 1915 under the auspices of the Dominion entomological service took place in the Lower Mainland and Island. It will be recalled that Mr. W. H. Brittain, who entered the Province in the spring of 1912 as Provincial Entomologist and Plant Pathologist, established his headquarters at Vernon, in the Okanagan Valley. The interior sections of the Province were thus under his care, and it may be stated that Mr. Brittain and the writer agreed to this tentative division of territory so as to avoid all possibility of conflict in the matter of investigating insect problems. Unfortunately, Mr. Brittain left the Province in 1913 to return to Nova Scotia. Mr. J. W. Eastham succeeded him at Vernon in the spring of 1914. Mr. Eastham, being a plant pathologist in leanings, delegated Mr. M. H. Ruhmann, his assistant, to conduct such studies as were necessary in entomology. Mr. W. H. Lyne, operating under Mr. Thomas Cunningham's division of Provincial fruit inspection, conducted certain field-work operations, assisted by his staff of local field inspectors, against the codling-moth. In the New Year of 1915 the new Provincial Court-house at Vernon was completed and the Provincial Entomological Branch took up its quarters in this building under the direction of Mr. J. W. Eastham. During the summer of 1915 Mr. Eastham decided to move to Vancouver, where he establisheed pathological headquarters in the Vancouver Court-house, the Vernon office being maintained under the direction of Mr. M. H. Ruhmann.

The only other publications of note during the years of 1914 and 1915 were those by Dr. Seymour Hadwen, Animal Pathologist at Agassiz, on tick paralysis, anaphylaxis of cattle, sheep and horses, and the warble-flies.

During 1914 no new serious insect pests were recorded, and with the exception of certain outbreaks of codling-moth and a severe infestation of locusts in the Nicola Valley little of interest occurred.

In 1915 two new insects of importance made their appearance, and both on Vancouver Island. In April, through the courtesy of Mr. Glendenning, the writer became aware of the presence of the black-currant bud-mite at Duncan. This mite had evidently been imported by a nurseryman at Somenos some three years previous from England or Scotland on currants, and the record of its appearance on Vancouver Island constituted an original record for the American continent, and, so far as I am aware, no other centre of infestation occurred in Canada or the United States until the close of this year 1920. During 1915 and 1916 steps were taken to eradicate the mite from British Columbia, and while great progress was made it is questionable whether the mite is exterminated.

Towards the latter part of April of 1915 a still more serious insect pest made its appearance, although it doubtless had been present in the locality for a great many years. I refer to the pear-thrips found on the Saanich Peninsula. It was too late in the year to take any material action against this insect, but full plans were laid down for the 1916 season in co-operation with Mr. R. M. Winslow, Provincial Horticulturist, to combat the pest in the orchards.

As a matter of history, not for personal reasons, I would like to point out that, with the exception of the field-work against codling-moth carried on by the Provincial Fruit Inspection and Horticultural Branches, I believe I was the only professional economic entomologist at work in the Province. Mr. M. H. Ruhmann was at Vernon, but he was so busily engaged in correspondence-work and field-control measures that he had little time for investigational work. The bulk of my work had been carried on at Coast points, and it was not until 1916 that the Okanagan Valley received any attention of an investigational nature. In this year the study of the life-history and habits of the codling-moth was commenced at Vernon, the work being undertaken by Mr. Ruhmann and myself. This was in July of 1916, but I have neglected to mention that previous to my visit to the Okanagan in midsummer we had to welcome Dr. A. E. Cameron, who came direct from Manchester University to British Columbia in March, 1916, as an officer of the Dominion Entomological Branch and as an associate of my own in the pear-thrips campaign which opened early in the spring. We were all very glad indeed to welcome Dr. Cameron to British Columbia, as it marked a very important step in the progress of economic entomology in the Province, as is evidenced by the amount of information on British Columbia insects collected and published by him during his stay in the Province. Unfortunately, he found his billet in Saskatchewan in the summer of 1917 after having remained in British Columbia for about eighteen months. In February of 1916 British Columbia lost one of its most active entomological members, a man who really bears the credit for having established British Columbia as a pest-free Province. I think it is safe to say that the Province until this time may be considered pest-free, inasmuch as it was a fact that while we had a number of insect pests of importance there was none that had so great a hold on the agricultural interests as to cause untold loss or worry. I refer to Mr. Thomas

Cunningham, who died in Vancouver in February of this year, and he took with him, in addition to the respect of all his associates, the main credit from an entomological standpoint of having established a world-wide reputation for the Province in the matter of its freedom from the codling-moth. I think there is no question about this and it is right to give honour where honour is due. Mr. Cunningham by his foresight and will-power laid the foundation-stones upon which we as officers of the Department who followed him have built.

In 1916, again several new insect pests not previously recorded for the Province were reported and determined by officers of the Entomological Branch. It may almost appear that the number of insect pests were increasing in due proportion to the increase of the entomological staff, but, of course, these insect pests doubtless had been present for several years and their identity had lain dormant until discovered by entomologists whose duty it was to investigate insect conditions. The pests that I have noted for this year are the chrysanthemum-midge, which was reported to me by Mr. R. M. Winslow and E. W. White, of the Provincial Horticultural Branch from Victoria; the mangel-root or sugar-beet aphis (**Pemphigus betæ**), reported to me by W. T. McDonald, Provincial Live Stock Commissioner from Victoria; and the apple-maggot (**Rhagoletis pomonella**), taken by myself at Penticton on July 26th, 1916, and identified by Dr. J. M. Aldrich, of Washington, D.C. The identity of the sugar-beet aphis was proved by Mr. W. A. Ross, of the Entomological Branch, Ottawa.

During 1916 the Bulletin No. 12 of the Dominion series appeared from Ottawa detailing the habits of the cabbage-root maggot. During 1917 the study of the pear-thrips on the Saanich Peninsula continued, with Dr. A. E. Cameron and the writer in charge. The results of this work were summarized into bulletin form during the winter of 1917 and appeared as Bulletin No. 15 of the Dominion series in January, 1918, in time for the opening of the spring campaign of that year.

Mr. W. Downes was engaged as temporary field assistant in the spring of 1917 to carry on the field data on the pear-thrips in the neighbourhood of Victoria. Mr. J. D. Tothill also visited the Province this year and opened up a field laboratory at Royal Oak, on Vancouver Island, to commence the study of tent-caterpillars, spruce-budworm, and fall web-worm. Mr. Tothill had charge of the natural-control features of Dominion Entomological Branch studies, and it was under the auspices of the Federal Government that he commenced work in this Province. His studies carried him far and wide throughout the Province, but Lillooet, the Lower Fraser Valley, and Vancouver Island claimed his attention to the greatest extent.

The most noteworthy economic insects discovered this year were the pea-weevil at Penticton and Summerland, reported to me by the Provincial Field Inspectors, and the apple-maggot at Victoria, discovered by Mr. Downes. The writer also undertook this year to investigate certain stored-product insects, and heat was used for the first time in the Province to control such insects. **Calandra oryza, Læmophleus ferrugineus, Tribo-**

lium ferrugineum, Plodia interpunctella, Dermestes vulpinus and **lardarius, Necrobia rufipes,** and **Tenebrioides mauritanicus** were found in cargoes of transpacific vessels. **Plodia interpunctella, Ephestia kuehniella, Tinea granella, Pyralis farinalis, Calandra oryza,** and **Tyroglyphus farinæ** were found in local mills and warehouses.

At this point I would like to diverge for a moment to another phase of entomological progress. It has been pointed out at various times that economic entomology in the Province has received its incentive for further action through the medium of the British Columbia Fruit-growers' Association and the Horticultural Branch of the Province. This is as much true to-day as in the years gone by, and in passing I feel it only right that we should mention the excellent work of Mr. R. M. Winslow, who officiated as Provincial Horticulturist between the years of 1909 and 1917. The establishing of known measures of insect-control as regular orchard procedures was very largely due to Mr. Winslow, and his sympathy for the solving of measures improperly known and the force he exerted to obtain results against new and imperfectly known insect pests was very great indeed. British Columbia suffered a very material loss in his resignation in July, 1917.

Mr. M. S. Middleton succeeded Mr. Winslow later in 1917, and through him a new series of horticultural bulletins, of which many were entomological in nature, was inaugurated. Mr. Middleton saw fit to resign his position in 1918, since when the office has been vacant.

During 1918 some changes in the organization of the entomological work took place which are worthy of mention. Agassiz, on the Experimental Farm, had been the headquarters of the Dominion Entomological Branch in the Province since 1912 and up until the close of 1917. It has been pointed out already in this paper that the Provincial headquarters had been maintained at Vernon from 1912 until 1918, at which time Mr. Eastham moved his headquarters to Vancouver. Mr. Ruhmann was left in Vernon, undertaking such entomological work that required attention, but he found that pressure of other duties interfered so materially with his insect-work that he was unable to accomplish very much. Furthermore, the development of the Federal work showed prospects of enlargement to such an extent that the quarters at Agassiz would shortly become too small. Furthermore, again, it happened that the greatest number of inquiries of an entomological nature were emanating from the Okanagan Valley, where it appeared the most serious insect problems were pending. It was decided, therefore, to transfer the Dominion headquarters from Agassiz to Vernon. This was done during the spring of 1918, and although the writer had spent the greater part of the two previous summers in the Okanagan Valley, this spring of 1918 was the first spring spent in the Interior.

It may also be worthy of mention, as a matter of history, that by request of the Provincial Department of Agriculture the direction of the Provincial entomological activities was turned over to the writer. In this way Mr. Ruhmann was relieved of a great deal of his executive work, which enabled him to undertake more insect-investigation studies.

Mr. W. Downes undertook the work necessary under the Dominion Entomological Branch on Vancouver Island, undertaking in particular the studies necessary on the strawberry-root weevil and pear-thrips. He was also able to prove the existence of the apple-maggot and its food-plant, showing that the species in British Columbia was a "biological species" not connected with the apple at all, but with the **Symphoricarpus** or snowberry. It was, however, in all other particulars identical with the typical apple-maggot of the East. Mr. Downes also received this year an impression of the parthenogenetic nature of the strawberry-root weevil adults, an impression which he verified the succeeding year.

The writer was able this year to bring to light in the Upper Country several insect pests which had not been noted previously. Chief among these was the alfalfa-seed chalcid, which was found wherever alfalfa was grown between the Lower Similkameen and Lillooet and causing a loss which varied from 25 to 75 per cent. in the seed-crop; the clover-seed midge at Victoria; the greater wheat-stem maggot (**Meromyza americana**) in the neighbourhood between Salmon Arm and Chase; and the pear-psyllia at Nelson. All of these insects rank in the forefront as economic pests and doubtless will need consideration at some time in the future. **Hemerocampa vetusta form gulosa** (the tussock-moth of the fir) was also reported from Armstrong, Chase, Salmon Arm, and Hedley during this year, and its presence has been noted every year until the present at the same points, with the addition of Vernon and Okanagan Centre. A species of **Lachnosterna** which was believed to be referable to the species (**dubia**) **anxia** was received from Blind Bay in the Shuswap area and Vernon. Mr. Downes also added **Synanthedon rutilans** and **Aristotelia fragariæ** among the injurious small-fruit insects of the Island.

In the spring of 1918 Mr. Tothill, as a result of his preliminary inquiries of the year previous, instructed his assistant, Mr. A. B. Baird, to repair to British Columbia for the purpose of undertaking a systematic study into the parasitism of the tent-caterpillars, the spruce-bud worm, and fall web-worm. Mr. Baird made Agassiz his headquarters and he remained in British Columbia until the close of this present year 1920, when he returned to his headquarters at Fredericton, New Brunswick.

British Columbia was honoured in the autumn of 1918 by a visit from Dr. C. Gordon Hewitt, Dominion Entomologist. Dr. Hewitt, of course, was not a stranger to British Columbia, inasmuch as he had visited the Province on the average of every other year since his appointment in Ottawa in 1909. However, on this occasion his visit was noteworthy because it added just one more milestone to the progress of entomology in the Province. The Lower Fraser Valley has always contended against the mosquito plague, and public opinion was aroused to such a pitch that the writer was enabled to arrange a meeting with the Vancouver Board of Trade, the Reeves of the Fraser Valley municipalities, and Dr. Hewitt this autumn. The meeting was held at Mission, with Mr. C. E. Tisdall in the chair, on September 10th. Dr. Hewitt promised to appoint an officer from his

Branch to investigate and report on the biology and species of the mosquitoes present in the valley and to assist the municipalities by general advice and suggestion. The Vancouver Board of Trade undertook to draft a "Mosquito-control Act" which could be submitted to the Provincial House for discussion and endorsation. Unfortunately, the endeavours came to naught owing, I believe, to lack of co-operation among the municipalities, but Dr. Hewitt fulfilled his part of the bargain, and next spring we welcomed Mr. Eric Hearle to British Columbia with special instructions to investigate the mosquito problem.

In 1917 Mr. R. N. Chrystal, of Dr. Swaine's Federal Division of Forest Insects, left the Province this year to undertake certain work elsewhere in the Dominion. Mr. Chrystal had been engaged in preliminary studies of forest insects in British Columbia for two years and his major inquiries centred in Stanley Park at Vancouver. A laboratory was established in Stanley Park for the purposes of close investigation, but this was abandoned when Mr. Chrystal left for the East.

So far as the Provincial entomological service is concerned, in addition to the services of Mr. M. H. Ruhmann at Vernon, we have to record the entrance of Mr. E. R. Buckell to the field insect-work. Mr. Buckell was attached during 1918 to the Horticultural Branch of the Province and was engaged in codling-moth eradication at Walhachin. In 1919 he joined the entomological service proper and was placed at Penticton to investigate the peach-twig borer and the locust situation in the Lower Okanagan Valley. Mr. Buckell found his special field of investigation in insects affecting the range and cereals, so that during 1920 he made the Chilcotin District his headquarters. It is interesting to note that, so far as I am aware, this was the first time the Chilcotins have been visited to investigate any special insect problem. The sad depletion of the range from overgrazing and from the influence of locusts necessitated some action, and it is hoped that as a result of Mr. Buckell's investigations some measures will be adopted, in co-operation with the Provincial Range Commissioner, to better the conditions. Mr. Buckell intends continuing his investigations in the same area next year, 1921.

A matter of some importance which I have neglected to mention thus far in this paper in reviewing entomological progress in British Columbia is the school educational work under the auspices of the Provincial Department of Education. Mr. J. W. Gibson was appointed as Provincial Director of Agricultural Education during the winter of 1914–15 under the Federal grant used for that purpose. In 1915 he held his first short course for teachers at Victoria, and the writer had the honour of presenting the course in entomology. It is felt that this work may have a very direct bearing on the future of entomology, as the teachers who were thus instructed undoubtedly obtained a wider knowledge on insect-life which they could impart to their students in all parts of the Province. A similar course has been held in Victoria during July of 1916, 1917, 1919, and 1920. The writer has conducted this course each year under Mr. Gibson's direction,

ably assisted in 1917 and 1919 by Mr. E. H. Blackmore, who undertook to give instructions in the determination of the important families of the Lepidoptera.

With the opening of the 1919 season the following officers were actively engaged in economic-insect investigations: Mr. W. Downes, who during 1918 and 1919 had been on temporary employ of the Dominion Entomological Branch, was appointed as permanent officer of the Dominion Branch on September 1st, 1919; Mr. E. P. Venables, who had recently returned from active military service in Palestine, was placed on temporary employ on the Dominion Branch for six months dating from May 15th until November 15th; Messrs. M. H. Ruhmann and E. R. Buckell under the Provincial Service; and the writer, who assumed general direction of the work. It will be seen that the Dominion and Provincial services are now co-ordinated so as to prevent overlapping of industry. The necessary projects are now grouped under crop insects: Mr. Downes, located at Victoria, was placed in charge of small-fruit investigations; Mr. Venables, at Vernon, on tree-fruit studies; Mr. Ruhmann, on vegetables; and Mr. Buckell, on range and cereal insects. In addition, Mr. Hearle, at Mission, is continuing his studies on the mosquitoes, and Mr. Baird, at Agassiz, on natural-control features of certain insect pests. Furthermore, the field officers of the Provincial Horticultural Branch were engaged in collecting data and reporting the existence of insect troubles in their respective districts, and the quarantine and inspection work under the direction of Mr. W. H. Lyne in Vancouver was productive of many notes of entomological interest. Thus the work was planned for 1919.

The year 1919 was productive in the following notes of special entomological interest: The writer received the work of **Marmara pomonella,** a lepidopterous fruit-miner, from Sorrento on October 25th. This same insect was noted by Mr. M. H. Ruhmann in 1917 in apples received from Creston on October 25th. The identification was made by Mr. Quaintance, of the United States Federal Entomological Bureau, Washington, D.C. In midsummer larvæ of **Mineola tricolorella** were taken at Okanagan Landing and bred through to the adult, the determination being made by Dr. J. McDonough, of Ottawa. **Argyroploce consanguiniana** was also reared from apple-foliage at Vernon. This insect had previously been noted from the Province in 1914, when it wa bred from larvæ taken on apple at Hatzic, in the Lower Fraser Valley. Mr. Downes, in addition to establishing the identity of many small-fruit insects from Island districts, this year reported **Apateticus crocatus,** a pentatomid bug predaceous on the caterpillars of the tent-caterpillar and oak-looper at Victoria. During May Mr. Buckell, in association with the writer, was able to establish the very interesting and doubtless important note on the existence of **Entomophthora (Tarichium) megaspermum,** an entomophilous fungous disease on noctuid larvæ attacking the **Chrysothamnus** bushes at Keremeos. The determination was made by Mr. Speare, Mycoentomologist of the United

States Bureau of Entomology, who remarked "that as near as can be determined the fungus is **E. Megaspermum** Cohn, which was described in 1873 and has never been recorded since as far as I am aware."

There is another phase of entomological endeavour which I have not mentioned thus far in this review, for the reason that it constitutes a separate branch of work. I refer to the Indian-orchard work. In 1911 the writer entered upon his duties in British Columbia to relieve our late lamented associate, Mr. Tom Wilson, of his duties as Dominion Inspector of Nursery Stock. Mr. Wilson previous to 1911 combined the duties at the Vancouver Fumigation Station with those essential to the establishment and safe-keeping of Indian orchards. He found the work necessary on the many Indian reserves in the Province so important that in 1911 he was enabled to spend his whole time superintending Indian orchards and agriculture in general. His work in this connection took him to all parts of the Province, and his astonishing knowledge of botany, zoology, and entomology made him an invaluable collector of insects and insect records. Mr. Wilson carried on his duties until March 6th, 1917, when he met an untimely death in a disastrous fire at the Coquihalla Hotel, Hope, B.C. His loss was felt most severely in a personal and professional way. The writer had the honour of writing his obituary notice in our Bulletin No. 10, 1917, but this only half expressed the high regard in which he was held. With Tom Wilson went a great mass of information on insect-life which never now can be published. His death was so sudden and unexpected that it was hard to realize the loss entomology suffered. If a moral could be pointed, it should be impressed upon us all that for the sake of the future we should make an endeavour to cover by writing the important established data which our experience produces. Mr. Wilson was succeeded by Mr. Walter B. Anderson in the spring of 1918, who has carried on similar duties that Mr. Wilson was performing at the time of his death. Mr. Anderson proved an inveterate collector and the National Museum in Ottawa has been enriched to a very considerable extent as a result of his labours.

The year 1919, as may be seen, proved an auspicious year for British Columbia. It remained for this last year, 1920, to show the greatest degree of development yet experienced in the Province. The progress made in British Columbia has been due to the foresight of the late Dominion Entomologist, Dr. C. Gordon Hewitt. I think it should be clearly borne in mind that while the local officials of both Federal and Provincial Departments of Agriculture have done all in their power to further the interests of entomology in the Province, nothing like the progress shown would have been possible without the support and endorsation of Dr. C. Gordon Hewitt. It was with feelings of deep regret that we heard of his untimely death by pneumonia in February of this year. The studies planned for 1920 were planned at a time previous to his death, and so I think we may still give Dr. Hewitt credit for the developments shown during this past year.

The first new face that we welcomed was Mr. Ralph Hopping, who was appointed under Dr. Swaine's Forest Insect Division, and who arrived in December, 1919, to take charge of special forest-insect investigations in this Province. Mr. Hopping came direct from California, and he brought with him not only the best private collection of beetles on the West Coast, but also a standard of knowledge on beetle-life which has been gained as a result of twenty years' experience in this group. He is regarded as one of the leading students on forest-insect life on the West Coast, and his allocation to British Columbia was not only a direct loss to the United States, but a most decided acquisition to Canada and to the Province of British Columbia in particular. The next most important item in this year's history is the advent for the first time into the field of entomology of students from the University of British Columbia. Three were employed this year. Mr. Alphonse Crawford, undergraduate in medicine, was delegated to assist Mr. Eric Hearle in his mosquito studies on the Lower Fraser; Mr. N. L. Cutler, biology student, was posted to the entomological laboratory at Vernon to undertake the collecting of insect specimens for the University collection, the specimens to be collected individually and in bulk for the use of the students at the University during this present winter; Miss A. C. Healey, art student, as laboratory assistant at the Vernon Laboratory. All of these students were on temporary employ for the summer months, terminating their services in time to return to Vancouver to continue their graduate studies.

Mr. A. B. Baird received temporary assistance this year in the person of Mr. R. Glendenning, and on the termination of the special natural-control investigations and the return of Mr. Baird to the East, Mr. Glendenning was enlisted for temporary service as assistant to Mr. Downes at Victoria. Mr. Buckell, as previously mentioned, went north this year to the Chilcotins on special range-work, and Mr. Ruhmann continued his studies of vegetable insects at Vernon, as did Mr. Venables on tree-fruit insects. Another innovation instituted at the Vernon Laboratory this year for the first time in the Province was the employment, under the Provincial Department of Agriculture, of two laboratory boys—boys who by reason of the fact that they showed unmistakable ability in natural-history studies were thought fit to pin, mount, collect, and take simple field-notes on insect-life in the field. It is hoped that if this idea is persevered in we may be able to build up entomologists for the future.

During this year, and commencing with the autumn sessions of the University, Dr. C. McLean Fraser, of the Marine Biological Station at Nanaimo, was appointed as Zoologist. Dr. Fraser lectured to the students during the 1919 sessions at the University, dealing with insects as a phase of the zoological science, and to him and to Dr. A. H. Hutchinson, Biologist, we are indebted for available students for field-work in the Province during the past year. Similar courses are again being held this year, but, I believe, for the first time, will a course be

held in economic entomology in the regular session at the University. The writer has the honour at this time to be giving this course.

During 1920 the following insects have been reported of economic interest: The Hessian fly was sent in to the Vernon Laboratory by the Superintendent of the Sidney Experimental Farm. This is a new record for the Province, although, judging from the present known area of infestation, it has been present for many years. Our information until 1918 was to the effect that while this insect was widely distributed west of the Cascades in both Washington and Oregon States, it was not known to occur north of Seattle. It is probable that this insect will cause very considerable trouble to fall wheat on the Island and measures for its control will have to be figured out. The satin-moth was reported by Dr. J. McDonough, of Ottawa, who determined this insect for Mr. A. B. Baird, who collected it. This moth is now only known to occur in British Columbia in the City of New Westminster, and the only other point at present infested in the North American Continent is Massachusetts. Hence it is believed to be an imported pest of recent standing, as it is common, I believe, both in Europe and Siberia. It is impossible at this time to state how important this insect may become during the next few years, but there is no question but that it will require careful watching. The Colorado potato-beetle, reported last year by Mr. W. H. Lyne for Gateway, in the Lower Kootenay country, was this year noted by Mr. W. B. Anderson at Waldo, a spread of 40 miles in a year. The currant elm-aphis, reported by Mr. Downes from Chilliwack and identified by Mr. W. A. Ross, of the Dominion Entomological Branch, Vineland, Ontario, as **Eriosoma ulmi,** is noted for the first time. **Anisandrus pyri** (the shot-hole borer of the West) was, I believe, introduced to our notice by Mr. J. W. Eastham, who obtained identification through Dr. J. M. Swaine in Ottawa. This insect was taken in the neighbourhood of South Vancouver. **Mineola tricolorella** was again reported from Vernon, while the studies of Mr. Venables have brought to light the following list from the apple: Bruce's measuring-worm, **Rachela bruceata, Epicallima dimidiella, Peronea maximana,** together with the established identity of other common fruit-infesting larvæ, such as the lesser apple-worm, bud-moth, and the dock false worm. Several other insects attacking fruit have been found, but their identity is not yet disclosed. **Peronea maximana** may be further mentioned for the reason that it is closely related to **Alceris (Teras) minuta,** an insect which is noted by Mr. J. R. Anderson in his Bulletin No. 12 of Provincial Department of Agriculture, and as long as I can remember this insect has been mentioned to me as being present in British Columbia, but no specimens had been received. It is just possible that **T. minuta** may have been confused with **P. maximana,** but of this we have no definite information. Of those insects Mr. Buckell has found infesting the range lands of the Province I cannot make mention at this time. Suffice it to say that he has enriched our locust knowledge by establishing the presence of about

sixty species of locusts and has obtained ecological notes and life-history data on the majority of these. **Diplotaxis tenebrosus** Fall was noted this spring injuring young apricot seedlings at Osoyoos.

This review has taken longer than I intended it should, and on reading it over it appears as though it were a diatribe on the features of professional entomologists and a history of the Branch development. I really do not intend that it should be such and must apologize if it appears so. I have not touched upon the very excellent systematic work that has been accomplished during the past few years by professional and private members of our Society, and the non-inclusion of these records in this paper is no reflection. I had intended only dealing with the economic history, and in order to do this effectively I must of necessity mention personal data. In closing, I merely wish to say that it is my hope that the same progress be shown in the next few years as I am sure you will all agree has been the history of the past few years.

A TALK ON INSECTS IMPORTED FROM THE ORIENT.

BY W. H. LYNE, INSPECTOR OF IMPORTED FRUIT AND NURSERY STOCK.

It is not my intention to discuss the point as to whether or not the San Jose scale was first introduced to this continent on nursery stock imported from Japan. The fact that it was discovered on shrubbery imported from Japan to San Jose, Santa Clara County, Cal., and thus established its name, I have no wish to dispute.

What I do know is that on more than one occasion San Jose scale has been found on nursery stock imported from Japan to British Columbia, and that within the last month several apple, pear, and peach trees from Japan were condemned here in Vancouver owing to their being infested with that particular pest.

The San Jose scale (**Aspidiotus perniciosus**) is not the only scale-insect imported from Japan. We occasionally come in contact with other species, such as the cherry-scale (**Aspidiotus forbesi, A. nerii,** and **A. hedera**), infesting ornamental trees and shrubs. There are often other subfamilies of Coccidæ, such as **Chionaspis, Mytilaspis, Diaspis,** and **Lecanium,** represented by several of their relative species.

On one occasion several egg-masses of the gipsy moth (**Porthetria dispar**) were found on the bark of **Arbor vitæ** trees.

Other interesting species of insects imported are the larvæ of several beetles, boring into the heart-wood or feeding on the roots of trees or plants. The giant borer, a species of the Prioninæ, has occasionally been found in roots or just above the crown of **Wistaria,** walnut, and other trees from Japan.

Probably the beetle attracting the most attention at the present time is the Japanese beetle, **Popillia japonica,** owing to its having become established in certain sections of the Eastern United States. It is supposed to have been imported in iris-roots from Japan. On a few occasions and very recently we have found several larvæ closely resem-

bling that of this particular beetle; some were taken from around the roots of **Thuja** and maple trees and others from the roots or iris-plants. They have been submitted to Ottawa for identification. Some have been identified as being closely allied to our native Anomolas, and others are in process of breeding to adults in order to determine their species. There have also been other insects of minor importance.

Insects infesting Stored Products.—Besides the insects that accompany nursery stock from Japan and a few other parts of the Orient, there are many species that infest the miscellaneous stored products imported to this country.

Some few years ago one might often notice along the wharves products such as rice, corn, beans, peanuts, etc., just landed from Japan, China, Malaya Straits, or Australia, simply smothered with insects.

It was a sickly sight sometimes to see a large consignment of rice with thousands of larvæ of the **Plodia interpunctella** moth crawling over the sacks or mats. A closer inspection of this writhing mass of larvæ might also disclose the presence of the Mediterranean flour-moth (**Ephestia kuehniella**) or the meal snout-moth (**Pyralis farinalis**). Then by way of a little seasoning might be added the rice-weevil (**Calandra oryzæ**) and the flour-beetle (**Tribolium confusum**). Prowling among these like a tiger in search of his prey would perhaps be seen the cadelle (**Tenebriodes mauritanicus**), not very particular whether he dines on a good fat weevil or a grain of rice. There may still be other insects in this miscellaneous assembly. Sometimes we notice the frivolous little chalcid or other parasitic flies, and even the little flour-mites, **Tyroglyphus.** Consignments of the other products referred to, including wheat, are liable to be infested with any or all of the insects mentioned.

One other lepidopter not referred to is the Angoumois grain-moth, which on some occasions has accompanied maize from Australia and Manchuria, also peanuts from Japan.

On one occasion a large consignment of maize arrived from the Orient badly infested with weevil, **Calandra oryza** and **granaria.** The little pests were so anxious to see Vancouver they climbed over each other until they formed pyramids 6 inches high on top of the sacks. It was very amusing to hear the remarks passed by the longshoremen watching them.

Within twelve hours after the maize had been landed on the dock very few of the weevil were to be seen outside of the sacks. It is perhaps needless to add the whole of this particular shipment was fumigated shortly after with carbon bisulphide, which ended the career of these objectionable little immigrants.

Pea and Bean Weevil.—Other weevil of perhaps still more economic importance are those of the **Bruchus** family, commonly referred to as pea or bean weevil. It has been necessary to fumigate large quantities of peas and beans from the Orient infested with those particular insects, **Bruchus pisorum** and **obtectus.**

Nutmeg weevil.—Another species of the **Bruchus** family play sad havoc with nutmegs. Shipments have arrived at Vancouver simply riddled and pulverized, and the excavated nuts filled with castings of the insects are not very nice when ground and sold as powdered nutmeg. Such offal has been refused entry into the Province.

Sweet-potato Weevil.—Another so-called weevil, but more resembling an ant, is the sweet-potato weevil (**Cylas formicarius**). Both sweet potatoes and yams from the Orient have been condemned at Vancouver owing to being infested with this insect.

Potato-tuber Moth.—Shipments of the common Irish potato from Australia and New Zealand have been condemned for tuber-moth **(Phthorimæa operculella).**

The commercial world is just beginning to realize the tremendous waste resulting from the many insects that infest stored products, and fumigation and other methods of combating them are becoming very popular. Thousands of tons of the imported store products referred to have been fumigated at Vancouver during the last fifteen years.

MAN'S INFLUENCE ON THE NATIVE FLORA, WITH SPECIAL REFERENCE TO INSECT PESTS.

BY J. DAVIDSON, F.L.S., F.B.S.E.

For many years I have been observing man's influence in changing the local flora from the natural evergreen formation of cedar and Douglas fir to one in which deciduous trees predominate. My attention was first drawn to this about eight years ago during a botanical visit to the district between Crescent and White Rock. About that time an accidental fire had spread through a large area of evergreen forest on the bench land along the Coast where maples formed the fringe of the forest. The conifers and many of the maples succumbed to the effects, and the whole area was left a bleak waste of charred logs and burnt soil. The fire occurred when the fruits of the maples were reaching maturity, and though many trees were fatally injured at the crown of the root they were able to ripen and disperse their seeds. Being on the windward side, the seeds were freely distributed over the burnt area, and in the following season millions of maple seedlings gave promise of a change to a deciduous forest.

A similar change was found on logged-over land between Point Roberts and the Indian reserve, where maples, dogwood, and other deciduous trees form a large proportion of the second-growth forest. The change of soil by the additional humus formed by fallen leaves, and the fact that light reaches the forest floor in spring, favoured the increase of flowering plants formerly unable to exist in the darkness of the evergreen forest.

As is well known, there is a distinct relation between the flora and the fauna. Many of the new plants are food-plants of insects, which in turn provide part of the food of birds. Such areas naturally become breeding-

grounds and distributing centres for insects which may become garden or orchard pests.

In studying man's influence on the flora of the Vancouver District, one has to obtain a glimpse of the original forest formation as a basis for comparison. Unfortunately, this cannot be seen in any part of Greater Vancouver, not even in Stanley Park, which bears abundant evidences of the logger's axe. We can tell, however, that the forest was predominantly evergreen, with alder and elder, willows and crab-apple, fringing the forest on boggy lands, and where the soil was too wet for Douglas fir to encroach; and maples, cherry, and dogwood along the slopes near the Coast.

In those days it was absolutely impossible to have a tent-caterpillar plague such as we have experienced during the past few years; there were not sufficient food-plants to support it; the coniferous trees limited the distribution of deciduous species and caused the starvation of millions of seedlings which germinated in the darkness of the evergreen forest.

With the advent of the logger, open spaces in the forest provided the necessary light for the success of deciduous trees whose seeds were distributed by wind or by birds, and some of those early intruders may be found in various parts of Greater Vancouver as fairly large trees.

With the establishment and development of the City of Vancouver, and subsequently of the adjacent municipalities, the wholesale clearing of property opened up large areas for the increase of deciduous trees, notably alders and willows, whose seeds are adapted for distribution by wind. The result is to be seen to-day in most parts of Greater Vancouver—and in other Coast districts—where, on much of the "wild land" and some of the "improved land," we see young forests of food-plants for insect pests, replacing the forests which so long served as a natural protection against their invasion.

Man has thus upset the balance of nature, and if left to herself Nature will gradually restore the former order of things and evergreen trees will again become dominant, because in this locality they constitute what is termed the *climax flora*.

As a step towards the rehabilitation of the normal forest, Nature must control the abnormal growth which followed man's overthrow of natural conditions; the tent-caterpillar is but one of Nature's agents in this work, and, judging by the results of the past few years, it has proved a very effective one.

It will therefore be seen that anything done to encourage the growth of certain species of deciduous trees will also encourage the increase of tent-caterpillars; and conversely, by encouraging evergreen trees and such species of deciduous trees as are not food-plants of the tent-caterpillar, we lessen the risk of future plagues.

To directly attack the tent-caterpillar by spraying vegetation on vacant lots is contrary to nature and tends to prolong the duration of the plague; by adopting this method we protect unnatural vegetation to increase the menace every succeeding year. It is better to assist in restoring the balance

of nature by demolishing the abnormal conditions which we have created, and by destroying *only those species which are food-plants of the tent-caterpillar* we remove the cause of the outbreak and prevent its recurrence.

For the past three years I have advocated this method of combating the tent-caterpillar plague, and last year the City of Vancouver took steps to carry this method into effect by having vacant lots cleared. But the clearing has been overdone, and on that account may have to be repeated in a year or two. Instead of destroying only food-plants, every tree and shrub was cut to the ground, piled into heaps and burned, with the result that a greater area is available for the growth of food-plants than existed before the ground was cleared, and much unnecessary expenditure was incurred in cutting down trees which were not only harmless, but were actually beneficial in hindering or limiting the establishment of food-plants.

Man's influence on the flora is therefore well illustrated in Vancouver; instead of vacant lots covered with various evergreen trees, vine-maple, cascara, dogwood, and other beautiful and harmless species, we have waste ground for the reception of wind-borne seeds of alder, willow, fireweed, thistles, dandelions, and other weeds, and the prospect of a continuance of the tent-caterpillar pest until a new growth of immune trees takes possession of such areas.

It should be emphasized that all deciduous trees are not food-plants of the tent-caterpillar, and those entrusted with clearing operations should be able to distinguish the harmful species from the useful. This can be done as easily in winter as in summer, and arrangements should be made to give the men sufficient instruction in the identification of trees as would enable the work to be done more effectively and more economically.

Last summer on a small area comprising almost one-quarter of a block, several men worked for the greater part of a week clearing off the vegetation; it so happened that on this particular area there were comparatively few food-plants of the tent-caterpillar, but there were many deciduous trees, including maples and cascara-trees; of the latter I counted ninety-four specimens of average size, besides a number of saplings; all were cut and burned. One man could have cut all the food-plants in one afternoon; approximately $80 worth of cascara-bark would have been saved from the flames, and the remaining cedars, Douglas firs, and maples would have provided shelter, protection, and nesting-places for birds, many of which assist in controlling insect pests.

TREES WHICH SHOULD BE CUT.

Amongst the local trees which are food-plants of the tent-caterpillar, and which alone should be destroyed on vacant lots, are alder, various species of willow, two species of poplar known as cottonwood and aspen, wild cherry, crab-apple, and hawthorn; the latter, though not in evidence in Vancouver, is very common in one or two municipalities in this region. The following shrubs are also food-plants: Flowering currant, wild roses,

and June-berry or saskatoon. In some localities these are so abundant as to constitute a menace to adjacent gardens and orchards, but unless the plants are actually attacked by the pest, isolated patches of these shrubs may be spared for the beauty of their flowers.

TREES WHICH SHOULD BE SPARED.

Amongst the trees which are immune to the attacks of tent-caterpillars are the conifers, including giant fir, cedar, hemlock, yew, Douglas fir, and pine. Spruce-trees attacked by the spruce-gall aphis may be destroyed. Maples, cascara, arbutus, Osier dogwood, and Nuttall's dogwood are all useful species and should be spared. Nuttall's dogwood is our famous large-flowered species and is practically immune to all insect and fungus pests. It is rapidly becoming extinct in Vancouver except as a garden plant, but is still found in abundance outside the city boundaries. If vacant areas were replanted with this tree it would add much to the beauty of the city and help to prevent the establishment of undesirable species.

I have endeavoured to show that the tent-caterpillar plague here is due to man's influence on the local flora, and that by using his influence in the right direction and in accordance with natural laws he may not only counteract the present outbreak, but will save future generations from a recurrence of the pestilential conditions we have had to endure for the past three or four years.

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